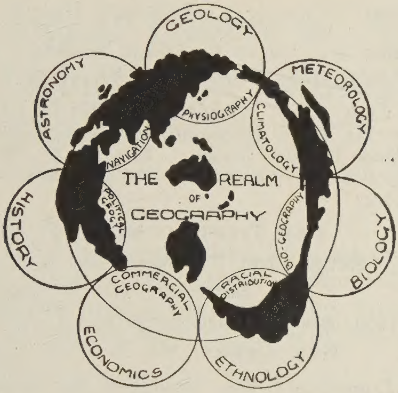
THE AUSTRALIAN GEOGRAPHER

Vol. 1
Part 3

May
1931



Hon. Editor: David G. Stead.

CONTENTS.

Page
Some Geological Factors in Australian Settlement and Industry—*W. R. Browne, D.Sc.* . . 3
The Mid North Coast of New South Wales—*G. Whalen* . . 19
The Geographic Background to Town Planning—*J. Macdonald Holmes, B.Sc., F.R.G.S.* . . 38
Dairy Production in New South Wales, 1924-25—*C. D. J. Back* . . 45
Population Density in New South Wales, 1921—*C. D. J. Back* . . 47
"Tea" Tree, not "Ti" Tree—*Editor* . . 49
Port Kembla and its Harbour—*E. A. Crago and A. G. Lowndes* . . 50
Egypt, The Sudan and The Suez—*J. Macdonald Holmes* . . 58
Tropical and Sub-Tropical Agriculture in Coastal Queensland—*John Andrews, B.A.* . . 62
Annual Report of Society . . 69
List of Members . . 72

Journal of The Geographical Society of New South Wales
SCIENCE HOUSE,
GLOUCESTER AND ESSEX STS., SYDNEY.

Price 2/- *(Issued Free to Members)*

THE GEOGRAPHICAL SOCIETY
OF NEW SOUTH WALES.

Science House, Cr. Gloucester and Essex Streets, Sydney.

GENERAL COUNCIL FOR 1930-31.

President: Professor J. Macdonald Holmes, B.Sc., F.R.G.S.

Vice-Presidents: Mr. David G. Stead; Professor W. R. Browne, D.sc.; Dr. Charles Anderson, M.A., D.Sc.; Miss D. R. Taylor, B.Sc.

Councillors: Capt. F. J. Bayldon; Dr. Marie Bentivoglio; Prof. L. A. Cotton; Mr. D. C. Ferguson; Mr. R. G. Gosset; Mr. H. W. Hamilton; Miss Evelyn Legge; Mr. H. B. Mathews Comm. M. H. Moyes, B.Sc., F.R.G.S.; Mr. A. L. Nairn; Miss E. Slack; Mr. E. P. Taylor.

Hon. Treasurer: Mr. M. F. Albert.

Acting Hon. Treasurer: Mr. A. L. Nairn.

Hon. Secretary: Mr. F. Daniell.

Hon. Assistant Secretary: Mr. J. Andrews, B.A.

Hon. Auditor: Mr. E. Gard Trouton.

Publication Committee: The President, the Hon. Asst. Secretary, and the Hon. Editor.

Hon. Editor: Mr. David G. Stead.

NOTICES

The Publication Committee will welcome suitable contributions to *The Australian Geographer.*

MEETINGS of the GEOGRAPHICAL SOCIETY OF NEW SOUTH WALES are held, unless otherwise notified, on the Second Tuesday in each month. In addition to the presentation of papers and lectures, members are reminded that Exhibits and Notes of Field Observations are welcomed. Visitors may be brought to the meetings.

Annual Subscription.—Ordinary Members, 10/- (5/- for latter half of year). **Associate Members,** 5/- per annum.

THE SOCIETY'S LIBRARY.

The Society is gradually building up a library of books, periodicals and maps, partly with the aid of generous donations from members. Gifts of this kind are always gratefully received. The Library is at the disposal of members, and is at present housed in the Geographical Department at the University.

THE AUSTRALIAN GEOGRAPHER

Vol. I. MAY, 1931. Part 3.

Some Geological Factors in Australian Settlement and Industry

By W. R. BROWNE, D.Sc.

(Presidential Address, given on 8th July, 1930.)

Introduction.—Every geographer will agree that man's activities are to a considerable extent influenced by his geographical environment, and though he may, to some extent, modify it, if he is to survive he must more or less adapt himself to his surroundings.

The geographical environment consists of a number of very diverse elements, but a large portion of it is geological, and the purpose of this address is to show that for Australia such geological factors as the rocks and minerals, the geological structures, the earth movements and the physiography have been, and are destined still to be, very important indeed in determining places of settlement, manner of living, industrial development and means of communication.

When we examine the population map of Australia, it is evident at a glance that climate is by far the most important controlling influence in regard to the present distribution of the inhabitants; the absence of an adequate and reliable rainfall has prohibited effective settlement over the greater part of the interior, while the temperatures of the northern parts have caused the bulk of the population to concentrate largely to the south of the tropic. In the populated parts, however, the nature and distribution of present and future settlement are bound up with a number of factors besides climate, and a great many of these are fundamentally geological.

Mineral Resources.—No one will dispute the fact that the natural mineral resources of a country are among its most important material assets. For present purposes we may recognise two chief genetic groups of them. First there are the ore-deposits originally introduced among the sedimentary rocks with molten igneous magma, and often occurring in more or less vertical veins, like the ores of gold, tin, lead, zinc and copper; some of these ores have been, through erosion and transport by streams, more or less concentrated at or near the present land-surface, and appear as alluvial deposits, while others are found in their original or in a modified form in the places in which they were first deposited from solution. Then there is a second great group, consisting of deposits essentially sedimentary in character, of which only the most important member need be considered—coal, with its various modifications.

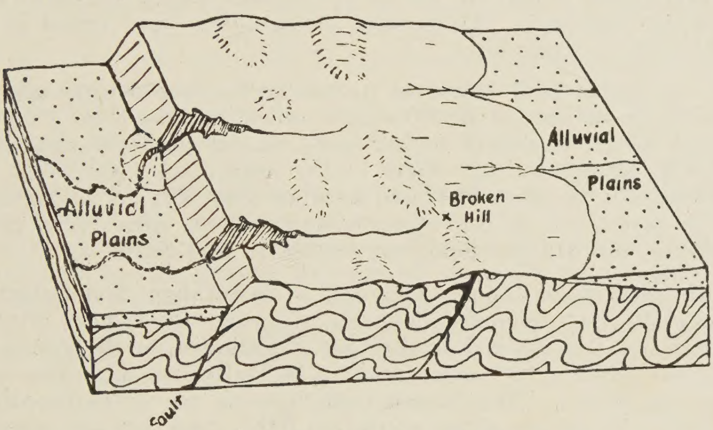
The story of the early days of gold-mining in Australia has in it many of the elements of romance, but it is well known and need not be recounted here. Those halcyon days appear to have ended long ago, and now gold represents but a small proportion of Australia's total mineral production. Compared with that of South Africa at the present time our output was never very high, and to-day it is only a fraction of that of our sister dominion. It is of course by no means certain that gold deposits of value will not be found in the future, but it is doubtful if the rather sensational alluvial discoveries of the past will ever be repeated.

However great may appear the direct contribution, some £630,000,000, which gold-mining has made to our material wealth, it must be remembered that the indirect effects have been far greater. It was the discovery of gold which gave the first real stimulus to immigration, and the population has since been increasing at approximately the rate established between the years 1850 and 1860. Many of those who in the first early gold-rushes came to dig remained to farm, and it is of course well known that many of our important provincial centres of farming, like Ballarat, Bathurst, and others, owed their original settlement to mining. What is perhaps not so well known is that a good proportion of the country in the south-west of Western Australia, as about Southern Cross, which formerly produced gold, is now producing wheat. This area has a low but reliable winter rainfall, and assuredly its agricultural value would not have been realised till much later had not the gold-seekers first blazed the trail of settlement.

In regard to other metalliferous deposits Australia has done well in the past with ores of copper and tin, and others of less account. The decline in the production of these is due in large measure to economic causes, though in some instances the best of the known high-grade deposits are worked out. In silver, lead and zinc, however, Australia still occupies a high position among the world producers, and if the high hopes which have been entertained in regard to Mount Isa and other deposits are justified, there is little to fear for the future. Since its discovery in 1887 the world-famed Broken Hill lode has produced silver, lead and zinc to the value of £150,000,000 sterling. Some eight years ago Mr. E. C. Andrews, Government Geologist, estimated that over 32 million tons of ore had been mined, and that another 20 million tons might reasonably be looked for; these are truly remarkable figures. This series of deposits has been responsible for the establishment and existence of a city whose population has at times exceeded 30,000 souls in the midst of what is virtually a desert area.

It is interesting to note that it is probably as the result of a geological accident that the Broken Hill lode appears as a surface outcrop. The inlier of ancient rocks which contains it is like an island in a sea of sand and other alluvium, and only for the Mundi-Mundi fault of about 900 feet throw, which helped to raise the area above the surrounding country, so permitting rivers to form and carry away the mantle of waste, the whole or most of the mineralised belt would be effectively buried.

To a manufacturing community iron ore is a requisite next in importance to coal. Australia has many deposits scattered through the different States, but the full extent of its resources can only be guessed at, since the demand for iron ore has not been great enough to warrant a detailed survey. The only deposits extensively worked at present are those near Orange, in our own State, and those of Iron Knob in South Australia, but many other deposits are known, as in the west and north-west of Tasmania, and at various places in Western Australia, notably Yampi Sound, north of Derby, and Wilgi Mia in the Weld Range. What is probably a liberal estimate or guess puts the resources of the Commonwealth at 5,270 million tons, yet this compares rather unfavourably with Great Britain's 39,000 millions or the 91,000 million tons of America. Our supplies, however, are likely to be quite sufficient for our needs for a long time to come.



Block Diagram of Broken Hill Region.

It would appear that our hopes of finding further large bodies of payable metalliferous ore are to be centred chiefly on the various methods of geophysical prospecting, by means of which the presence of deposits at depth, or buried under a waste-sheet, may be determined. It is quite possible that hidden lodes, as rich as any yet discovered, may be found by these means beneath the alluvium that covers large areas of ancient rocks in the central parts of the continent.

Much less spectacular than the ore-deposits, but much more important at present, and destined to be increasingly so as times goes on, are our coal resources. Reference is frequently made to our "inexhaustible supplies of coal," and it is therefore pertinent to inquire how far such an expression is justifiable. All the States have coal-fields of greater or smaller extent, and of very varying values. By far the most valuable deposits are those of New South Wales and Queensland, consisting of black coal. The main or Permian coal basin of New South Wales extends from the coast, roughly between Port Stephens and Nowra, in a broad belt for about 200 miles to the north-west, and contains the coal belonging to the Upper coal-measures together with the underlying less extensive Greta coal-measures, outcropping chiefly in the Lower Hunter Valley. Other Permian coal-measures of unknown extent have been found in the Riverina at Coorabin.

In Queensland measures proved to be coal-bearing are said to cover an area of 18,000 square miles, but the total area covered by coal-measure rocks, many as yet not investigated, is 73,000 square miles. Some of the seams are very thick, one being 57ft. another 66ft. and another over 90ft. The Mesozoic coal-measures of S.E. Queensland extend into New South Wales, but are practically unworked in this State.

Victoria has some black coal at Wonthaggi and elsewhere, and she has immense deposits of brown coal, very high in moisture, but utilized on the spot at Yallourn for the generation of electricity, which is transmitted to Melbourne and other parts of the State. The brown coal deposits are of extraordinary thickness, in some places exceeding 700 ft., and they are mined by open cuts.

Tasmania's coalfields lie in parts of the island where hydro-electric schemes are not to any extent possible, chiefly in the eastern and south-eastern parts.

South Australia's coal is chiefly brown, and though existing in moderate quantities is of low grade and occurs far from centres of population; for these and other reasons it is not at present being used. Western Australia in the south-west has considerable quantities of sub-bituminous coal which finds many uses in that State.

It is extremely difficult to give anything like an accurate estimate of Australia's coal-resources, since such large areas are as yet unexplored. The figures published by the International Geological Congress in 1913, modified by later discoveries, are:—

New South Wales	118,439 mil. tons
Queensland	15,218 mil. tons
Victoria	37,040 mil. tons
Tasmania	244 mil. tons
South Australia	57 mil. tons
Western Australia	3,500 mil. tons
Total	174,498 mil. tons

It is possible that the New South Wales estimate is somewhat exaggerated, and almost certainly that for Queensland is low. Indeed the resources of the northern State may be comparable with those of New South Wales. The figures would appear to lend justification to the view that we have unlimited coal in Australia, but it must be remembered that much of it is likely to be of only limited utility, and that quite a considerable percentage is lost in mining. When too, we compare Australia's figures with those of the very much smaller area of Great Britain (187 x 10^9 mil. tons) and those of U.S.A. (1400 x 10^9 mil. tons) our resources do not appear so staggeringly large.

Since coal is the life-blood of manufacturing industry, and therefore the most precious of our mineral resources, it should naturally be the one most carefully cherished, but actually it appears that a great deal of preventible loss occurs in connection with both its winning and its utilization, so that a wasting becomes in some degree a wasted asset. For instance a large percentage of the coal is left unmined either because of the necessity of leaving pillars to support the roof, or because it would be too costly to work the full face of a thick seam. Possibly some of this coal may be recovered at a later date when all the easily-won material is exhausted, but a large proportion, it is to be feared, will never be extracted. Then on our South Coast coalfields we see the lamentable volatilisation of precious bye-products through the manufacture of coke in beehive ovens, truly a burnt-offering upon the altar of present prosperity. Less wasteful methods would of course mean increased cost of production, but quite apart from other considerations surely in the interests of posterity the wastage should be reduced to a minimum.

At present the coal-output of Australia is about 15 million tons a year, but when, as is bound to happen before the world is very much older, the available supplies of petroleum are exhausted, it is certain that our rate of production of coal will vastly increase, since it will be then our principal source of liquid fuels. One type of coal, the so-called oil-shale, such as is found at Joadja, Hartley Vale, Newnes, Ardglen, and elsewhere in New South Wales, as well as in Tasmania, is mined solely for the extraction of its oils by distillation.

The mention of oil naturally suggests consideration of the petroleum possibilities of Australia. The presence or otherwise of available supplies of oil in commercial quantities remains yet to be proved, and we have in our midst both oil-optimists and oil-pessimists, the grounds for whose respective hopes and fears appear to be about equally solid.

There are two main essentials for the occurrence of oil in commercial quantities; one, the existence of strata containing abundance of remains of plant and animal organisms to produce the oil, and the other the existence of geological structures which will make possible the concentration of the oil. It should be emphasised that the existence of one set of these conditions without the other is quite valueless.

If we in Australia have really been denied this natural resource it is a deprivation indeed, but it is yet much too early to despair of finding within the Commonwealth itself, or possibly in its New Guinea dependencies, such supplies of natural oil as shall make us independent of outside sources.

Such, then, is a rough and brief review of the chief elements in our mineral wealth. The value of the total mineral production to date is close on £1,200 million, gold occupying pride of place with about £630,000,000, coal coming second with about £225 million, while silver, lead and zinc together occupy third place. These wasting assets have therefore contributed in a very marked degree to Australia's material prosperty. Mining, and particularly metal-mining, is sometimes referred to as a "robber industry," presumably because the minerals once removed from the earth are gone for good, and their extraction produces no permanent settlement. But the term seems rather unfortunate and somewhat misleading, because that which is extracted is of no actual value at all until after it is taken out and thereby made available for human use; in other words mining gives value to that which before was valueless. Agriculture and other branches of farming might almost as aptly be termed robber industries, since they take permanently from the soil elements of value whose continued removal ultimately renders the land useless.

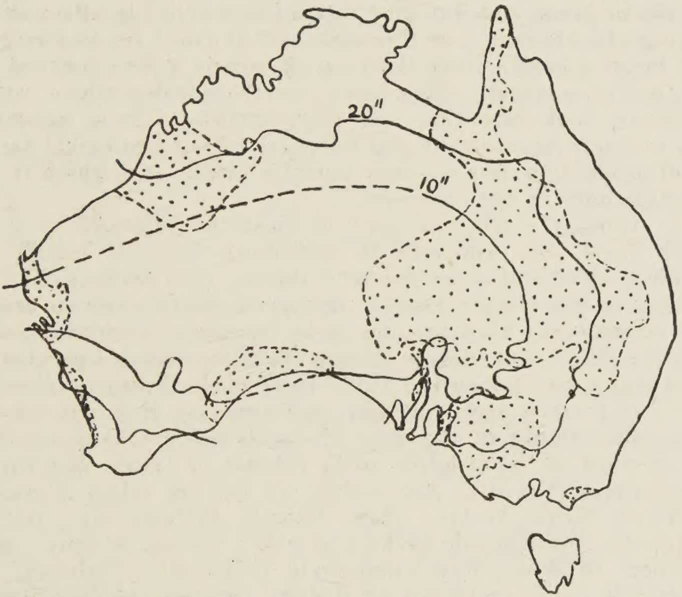
To her mineral resources Australia has owed much in the past, and one of them—coal—is bound to be a chief cornerstone in the structure of her future industrial development.

Artesian Water.—If the convex structures or domes of Australia have hitherto proved disappointingly empty of oil, certain concave ones, to wit the basins, have yielded abundantly a still more needful fluid. The artesian basin is a natural underground reservoir, the waters which seep from the surface deep into the layers of porous rock being preserved from evaporation and kept in a structural basin under natural pressure which forces them up toward the surface when tapped by bores or wells. In our Great Artesian Basin, covering an area of more than 600,000 square miles, we have what is probably the largest structure of its kind in the world, and altogether an area of about 1,100,000 square miles, or more than one third of the total area of the continent, is covered by this and smaller basins.

The daily flow from flowing (or true artesian) bores is between 400 and 500 million gallons, and from a great many sub-artesian wells the water is pumped as required.

This water is available very largely in the areas which by reason of low rainfall are most in need of it, and although for the most part too highly impregnated with dissolved mineral salts to be of use for irrigation, it has proved of immense value in watering stock, and thus increasing the carrying capacity of the land in some of the drier areas. A certain quantity is also used for domestic purposes and town-supplies.

There is evidence, in the shape of diminishing flow, that the supply of artesian water is not unlimited, and it is gratifying to know that as a result of the representations of Government geologists and hydraulic engineers, steps have been taken by the various State Governments concerned to check the waste of one of our most precious natural assets.



Relation between Principal Artesian Areas (dotted) and Annual Rainfall in Australia.

Geological Factors in Farming.—Although less than 1 per cent. of the area of the Commonwealth is under crop, nevertheless agriculture plays a very prominent part in our national activities, and furnishes a substantial portion of our production and our income. Certain forms of agriculture make for relatively close settlement.

It may be granted at once that climate is the primary condition influencing agriculture, but it is none the less true that the farmer is in a very great degree dependent directly and indirectly on geological conditions. Most of the intensive cultivation is done on the rich alluvial flats along the valleys of mature and old rivers, and these have been brought into being as the result of the rivers in flood-time overflowing their banks and spreading their burden of mud and silt, derived ultimately from the weathering of rocks further upstream, over the surrounding lands. The great value of these alluvial lands is indicated by the close agricultural settlement along, for instance, the Lower Hunter and some of our North Coast rivers, and by the high prices that are paid for the much-coveted river-flats. Not even the danger of floods is sufficient to discourage settlement on these rich agricultural areas.

But there are also the very extensive tracts of sedentary soil to be considered, derived from the decomposition of the rocks in place, and though climate has a very big effect in modifying the character of this soil, still it takes its characteristics in large measure from the rock of which it was formed, while its utility is largely a function of the three independent variables, climate, rock-formation and physiography. It is unnecessary to multiply examples of the influence of the geological factor in soil-production, but we may consider briefly one which is rather conspicuous in our continent.

Along the whole length of Eastern Australia in a broad belt there are remnants of enormous flows of basalt which were poured out over the land during the Tertiary Era when much of the country was a peneplain fairly close to sea-level. Remnants only they are, for there has been tremendous erosion of the flows, not merely during Tertiary times, but also since the major uplift occurred at the close of the Tertiary which gave us our eastern and southern highlands, so that what we now see outcropping in the way of basalt represents probably but a fraction of the original total volume of lava. Not far from Sydney, on the Blue Mountains, we can see relics of once continuous flows, at Mts. Hay, Tomah, Wilson, etc., and quite probably the volcanic necks and dykes around Sydney were the feeders of flows, now completely removed by erosion, which formerly covered the site of the city and the surrounding country. We find these basalts on our New England, Central and Southern Plateaux, as well as on our Western Slopes, and they extend across the border far into Queensland, forming among other areas, the famous Darling Downs. In Victoria a considerable area of basalt country stretches to the north and west of Melbourne.

In the moister areas the weathering of these rocks produces, according to situation, a black or chocolate soil, very rich in mineral plant-food, and much in demand for wheat-growing and general farming. Of the Queensland basalt areas Professor H. C. Richards writes:—"What Queensland owes especially to Cainozoic volcanic activity for her rich coastal strip carrying valuable softwoods under natural conditions, and flourishing sugar cane, bananas and maize crops and dairying pastures under the hand of man, can only be understood by those who have travelled the Queensland coastal strip of from one hundred to two hundred miles in width right from the rich Northern Rivers district of New South Wales, up to the base of Cape York Peninsula.'" We, in this State, owe just as much to our basalts, and the relatively high proportion of cultivated land in Victoria is due in great measure to the widespread flows of Tertiary basalt there. As a result of the very rugged nature of the physiography Tasmania has not a great amount of land, basaltic or otherwise, that is cultivable.

As has been mentioned, much of the basalt has disappeared through erosion. That which was carried off by the easterly-flowing streams has been largely swept into the sea and so lost to us, but that which was borne away by the western rivers was spread out far and wide as flood-plains to the west of the plateau areas, and now forms the valuable alluvial black-soil country of the Western Slopes.

Of course we have our barren treeless red-soil basalt country out to the West, and about Merriwa and Cooma; there, however, the fault lies, not with the soil, which is rich in mineral plant-food, but with the unfavourable dry climatic conditions.

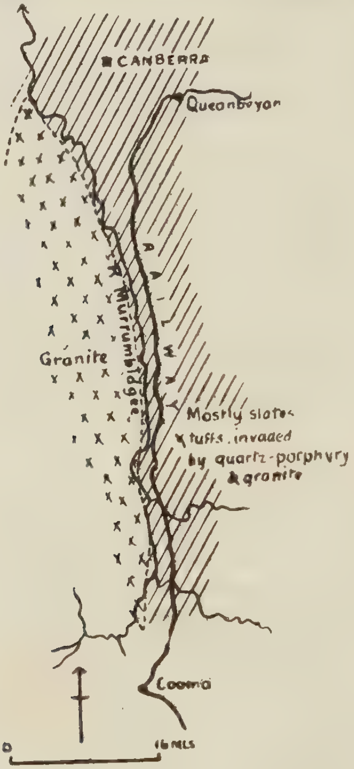
In the old days "when every rood of ground maintained its man," when populations were largely rural and nations had not become industrialized, much of what was taken from the land in crops was returned to it in due course as manure, and deterioration of the soil was slow. But in these latter days, when there are large urban populations to be fed and clothed, the produce of the earth, both plant and animal, is largely exported from the rural areas in the shape of wheat, potatoes, fruit, wool, meat, etc. To maintain the fertility of the soil, and repair in part the wastage, the farmer has to rely on artificial fertilizers, and here again, we find a geological basis not merely for agriculture but also for the pastoral industry, because the raw materials of these fertilizers are really rock-formations. The continued growing of wheat removes considerable quantities of phosphoric acid from the soil, and the same substance helps to build up the bodies of sheep and cattle that are grazed on the land. It has been estimated that Australia exports to other countries in the shape of wheat, flour, bran, etc., phosphates to the value of about £100,000 yearly, equivalent to more than 11,000 tons of phosphoric acid. A considerable quantity must also be exported from the cattle and sheep areas each year in the form of meat, and this takes no account of the wheat and meat used to feed the populations of our own cities. With our great and growing pastoral and agricultural production the use of superphosphate of lime to restore some of the condition to both grazing and cultivated land is increasing. The chief raw material is phosphate-rock, composed of phosphate of lime, and practically our sole sources of supply are Ocean Island and Nauru in the Gilbert and Ellice Group. Here the coral-rock has been converted into phosphate of lime by the phosphatic solutions due to leaching by rain of the guano deposited on the island by millions of sea-birds. In the phosphates of these islands Australia has an interest, with Great Britain and New Zealand. The total quantity of available phosphates is estimated at something over 100 million tons, and it is being removed at a rate which is at present about 500,000 tons a year, and is increasing. Even at the present rate the supply will last for not more than 200 years, and very probably it will have given out earlier. The world as a whole contains very considerable deposits of phosphate-rock, but they are principally in the Northern Hemisphere, especially in Northern Africa and United States of America, easily accessible to the primary producers of other parts of the world, but far away from, and therefore expensive for, us. Australia does not appear to contain much phosphate-rock, the largest deposits being in South Australia, and with the exhaustion of our present source of supply we should be at a very great disadvantage in competing with our primary products in the world's markets. It would seem prudent, even at this early date, to explore the possibilities of finding other sources of phosphates, either among the islands of the Pacific, which have already been partially investigated, or else possibly among the richly fossiliferous Tertiary marine strata so abundantly developed in the lowlands of New Guinea, which may include phosphatic shales or limestones like those of U.S.A.

Influence of Physiography and Late Geological History.—The settlement and progress of the Commonwealth have been affected in many ways by the physiographic structure of the continent, which is a consequence of its later geological history. There is some evidence that in the Tertiary era much of what is now Australia was flat or gently undulating and rather monotonous country nowhere a great deal above sea-level. In particular, it has been shown, by the work of E. C. Andrews and others, that what are now our eastern highlands and coastal areas must have had but little physiographic relief, and were at best mildly furrowed by wide mature or senile river valleys. Small uplifts followed by mature dissection alternated with subsidences till the close of the Tertiary, when a series of slow and somewhat intermittent and differential uplifts took place, raising the old surface to heights varying up to a maximum of 7300 feet, and converting the peneplains into plateaux, sloping gently to the west but giving more abruptly on to the eastern coast-lands. In other parts of the Continent there are evidences of this late Tertiary differential elevation, as in the "Tiers" of Tasmania, the faulted plateaux of the Mount Lofty, Barossa, and Flinders Ranges in South Australia, and the Darling Plateau and Kimberley Plateau in Western Australia. Not all the area of the continent, however, experienced the same degree of uplift, and some parts appear to have had little, if any. The interior is therefore in part plateau, in great part low-lying areas, plains of erosion or of deposition, in part really raised sea-floor.

The highlands have since their elevation suffered to a greater or less degree dissection by rivers which were either brought into existence or else rejuvenated as the result of the uplift. But since this dissection is far from completed there are large areas, as, for example, on the Main Divide in New South Wales and Queensland, where the face of the country-side retains, almost unfurrowed by time, the lineaments which characterised it in the days of the Tertiary peneplain. If we cross the Monaro plateau from Cooma to Adaminaby for instance, we shall see mature undulating upland country which reminds us very strongly of that which we get about Goulburn, or Mudgee, or farther north in the western parts of New England, and when we cross the border into Queensland, the Darling Downs, with their broad alluviated valleys and their areas of upland, rising to higher but accordant levels, will remind us of what we have seen in the highlands of our own State. Where, however, on the western and especially the eastern margins of the plateau, the rivers have already accomplished much erosion the plateau is greatly dissected and we get broken rugged country, difficult of access, almost impenetrable, and for most purposes quite useless. Tasmania has suffered so much from elevation and subsequent dissection that a large proportion of it is high tableland deeply incised by river-gorges and in parts almost unexplored.

As a result of its physiographic history, Australia's scenery on the whole lacks the grandeur and magnificence which characterise certain portions of other continents where mountain-building movements have upreared great chains of lofty highland, now sculptured into towering peaks by ice and other agents of erosion. Nevertheless the scenery of our dissected uplands has a charm all its own, and on the other hand there are compensations of a practical kind for the fact that Australia is, physiographically, a "low" continent. In regard to land-transport the physiography is an advantage, for there are no formidable mountain-barriers to be crossed by perilous passes or pierced by corkscrew tunnels. On those parts of the plateau as yet undissected the old Tertiary land-surface provides comparatively easy routes both transverse and longitudinal, while our vast expanses of plain country, often uninterrupted, unfortunately, even by water-courses, permit of the making of long straight stretches of railway and road.

A study of a large-scale map of Australia will show the important influence of mature river-valleys in opening up routes for settlement; two notable instances may be given from New South Wales. The railway-line from Queanbeyan to Cooma is virtually straight, and its route has been determined by the valley of the Upper Murrumbidgee which follows a marvellously straight sub-meridional course from near Cooma to the neighbourhood of Canberra. This course in its turn was pre-determined a great many geological periods ago, when at the close of the Silurian Period a series of soft shales, tuffs and limestones was folded along north-south axes, and a great bathylith of granite about 60 miles in length was injected along what is now the western wall of the valley, while a series of intrusions of quartz-porphyries and other hard igneous rocks was strung out some distance to the east. Between these resistant masses the river and its tributaries have in the course of ages hollowed out an elongated trough or valley in the soft sedimentary rocks, and this has provided a natural and comparatively easy route for both railway and road.

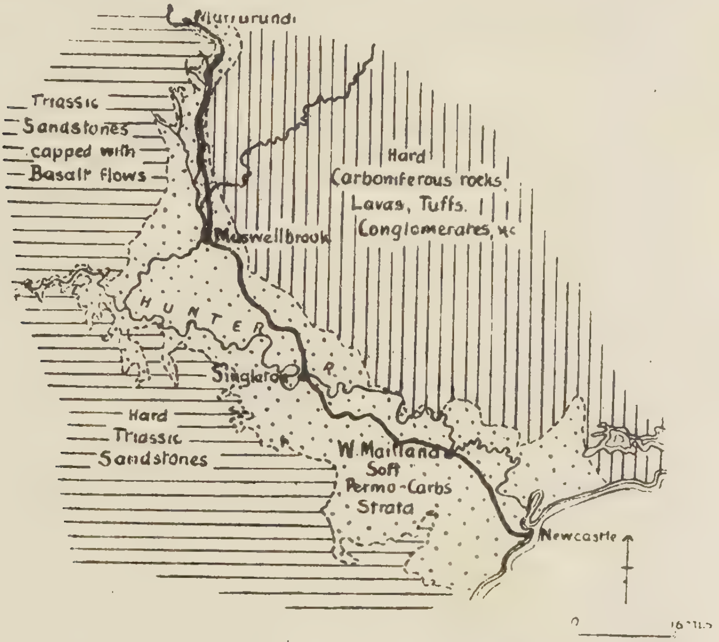


Map of Part of Upper Murrumbidgee Valley, showing interrelation of Geology, Physiography and Railway Communication.

Another and more important example is furnished by the Hunter, along whose valley lie the main arterial communications with the Northern Highlands. From Newcastle to Muswellbrook the broad main valley is used, then both railway and road follow up a minor but mature tributary almost to its head before finally climbing on to the higher levels near Murrurundi.

The Hunter Valley is floored mainly by soft Permian sediments, and is confined between walls of resistant Carboniferous rocks to the east and north, and cliffs of hard Trassic sandstone on the west and south, and its course has been in an important degree influenced by an old geological fault which marks the western boundary of the Carboniferous formations.

The mature and old valleys have also of course been instrumental, as pointed out above, in making available large areas of rich alluvial land for agriculture where the climate is favourable,.and settlement in some places, as along the North Coast of New South Wales, still tends to cling to the rivers whose valleys were the original avenues of exploration of the pioneer inhabitants.



Map of part of the Hunter Valley, showing interrelation of Geology, Physiography, and Railway Communication.

The dissection of the highlands by streams, still in progress, has resulted in the production of youthful valleys with deep gorges and waterfalls. While this has rendered much of the country unsuitable for settlement, the rivers themselves are of very considerable actual and potential value to the Commonwealth. One way in which these youthful valleys have been utilised is for the storage of water for irrigation or for city water supplies. Such storage schemes have made possible the existence of large communities on the Kalgoorlie Goldfield of Western Australia, and at Broken Hill in this State, in areas of very low rainfall. All the capital cities draw their supplies from reservoirs in the youthful valleys cut in the neighbouring plateaux since the late-Tertiary uplift. Sydney is particularly fortunate in this respect, since to the south stretches a long gentle slope rising from sea level to heights of 2000 feet and more, the "Nepean Ramp" of Professor Taylor, in which a series of consequent, or more probably revived, streams, the Nepean and its tributaries with some minor rivers, have cut deep trenches affording ideal conditions for water-conservation. One after another they are being pressed into service to supply the needs of the growing city, and further schemes for augmenting the storage involve the damming of the Warragamba in its gorge near Wallacia.

Irrigation is also being practised with the aid of storage reservoirs on our youthful and early-mature streams. Mention may be made of the many schemes in operation in Victoria on the Goulburn and other southern tributaries of the Murray, of the Hume Reservoir on the Murray, and of our own Burrinjuck scheme and the Wyangala Dam on the Lachlan, now under construction. South Australia has an extensive system of reticulation by pipes from reservoirs in the hills to the low-lying poorly watered country lying to the west of them. Queensland has projected an ambitious irrigation scheme in the Dawson Valley, which is expected to make possible cotton-growing.

We have not yet done much more than make a beginning with the task of converting the potential energy furnished by our youthful streams into kinetic energy in the shape of hydro-electricity. More or less detailed surveys of our water-power resources have been made, and it has been estimated that there is about 350,000 horse-power available from the rivers of New South Wales and nearly 127,000 from those of Victoria. In this State electricity is already being generated at Burrinjuck and conveyed down the Murrumbidgee as far as Wagga Wagga, the necessary head for the water being provided by the irrigation-dam, and on the Nymboida, a tributary of the Clarence River, a scheme is operating for the supply of electricity to Grafton and other towns. A proposal has been made to dam the Clarence itself and by means of the head thus obtained to make available over 70,000 horse-power, and it has been stated that the head-waters of the Snowy River near Jindabyne could be made to provide over twice as much power. In addition there are considerable falls on the headwaters of some of our rejuvenated east-flowing rivers, which might be utilised. Our knowledge of the hydro-electric possibilities of this State are due very largely to the untiring and enthusiastic labours of the late William Corin.

Queensland has contemplated generating electric power from the Barron Falls, with a drop of more than 800 feet and possibly from the Dawson Valley Dam when it is completed.

But it has been left to Tasmania to lead the way in making use of her physiographic advantages for water-supply. High up in the centre of the island between 2000 and 4000 feet above sea-level, is a series of lakes, some of them probably of glacial origin; the highlands are also deeply trenched by rivers, some of which drain these lakes. By utilising the head so obtainable it is estimated that no less than one million horse-power could be made available in the island, and of this about 7 per cent. is being utilised at present, chiefly in what is known as the Great Lake Scheme.

Since in general, youthful valleys with relatively steep gradients or with waterfalls are essential for the generation of hydro-electricity, and since these are found in greatest abundance along the eastern and southern portions of the Main Divide, it would appear that, whether the power of the future is to be provided by water or coal or both, the manufacturing industries are destined to be concentrated in the eastern portions of the continent.

For the actual and potential value of our youthful streams, and for all that they may mean to settlement and industry, the physiographic structure of the country, which is a direct consequence of its late geological history, is responsible.

It must be remembered also that but for the uplift and dissection of Eastern Australia in all probability our main coal-fields, or those of New South Wales at all events, would have remained buried and undiscovered. An inspection of the geological map of the State, or better still, perhaps, a study of the admirable block-diagram forming Plate XVIII. in "The Mineral Industry of New South Wales" will prove this beyond peradventure. It would appear, therefore, that the settlement and industry due primarily to the presence of our main coal-basin have been secondarily dependent on the Tertiary earth-movements which led to the revelation of its existence.

Much of our coast-line shows signs of submergence in geologically recent times, and of slight emergence at a still later date, and the first of these movements has played a major part in determining the sites of our chief centres of commerce and population. The deep drowning of youthful valleys often results in the formation of good natural harbours, with embayed shorelines and deep water right to the land, and it is to such drowning that we owe our own Sydney Harbour, with its countless bays and coves, and its 180 miles of shoreline. The ports of Melbourne, Hobart, Albany and Fremantle are other outstanding examples of the economic effects of coastal submergence.

An emergence of some twenty feet is the latest movement of any importance of which there are evidences around our coasts, and these evidences are observable in all the States. The results of the emergence have been mainly, through shallowing of the offshore waters, to facilitate and expedite some of the constructive processes of coastal erosion, and by relative movement of land and sea to form coastal plains. To this latest emergence we owe the ocean-bathing beaches of which we are so proud; many of them have resulted from the building up of a sand-barrier between an island and the mainland, or across the mouth of a shallow bay or estuary. Further there has been reclamation of much land that originally formed the floors of shallow bays and coastal lakes and estuaries, as about the mouth of the Macleay and Hunter Rivers, along the shores of Lake Macquarie, Botany Bay, Lake Illawarra, the Gippsland Lakes, Port Phillip, the Lower Murray and elsewhere. This land is low-lying, and much of it is sandy or marshy and subject to flooding; some of it is used for residential sites and for farming and gardening, but a great deal of it, in this State at all events, has been devoted to recreational purposes, and one finds on it parks, showgrounds, playing-fields, aerodromes, and perhaps most abundantly, racecourses.

It would appear, then, that in regard to some of the proclivities with which as a people we are generally credited, the coast-living part of the population at all events may fairly claim that they are merely reacting to their environment, and taking advantage of facilities provided by nature when last our coasts "arose from out the azure main" some few thousand years ago!

Conclusion.—In the foregoing remarks an attempt has been made to show that the geological influences are not the least of those by which our individual and national activities are governed and controlled. We find ourselves almost at every turn, directly or indirectly, dependent in some degree on the results of those geological processes which have moulded our continent, and he who would study our past and predict our future progress can by no means afford to leave them out of account.

But it must be remembered that this "human geology" if one may call it so, forms but a part, though an important part, of the larger science of human geography, a many-sided study of surpassing interest in itself, and one whose importance to the community is very imperfectly realised. Its practical aspects merit special emphasis in a country like our own, whose future development will surely be beset with perplexing problems with which the geographer is peculiarly fitted to grapple. Is it too much to look forward to a time when we shall have a community educated in geographical principles, appreciating the importance of geographical environment, and with some understanding of Australia's limitations as well as of its possibilities? Then indeed we shall be in a position to avoid the mistakes of the past; then, and then only, shall we be able to develop to the best advantage this great continent which is our heritage from our forebears, and of which we must regard ourselves as stewards and trustees for the generations that are yet to come.

The Mid North Coast of New South Wales

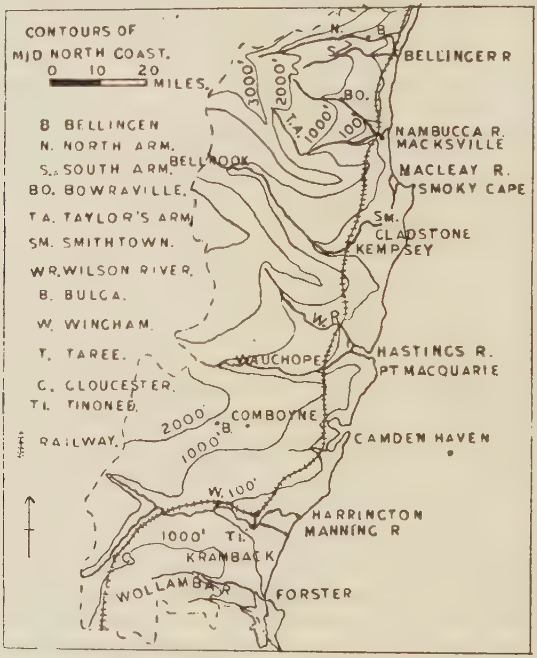
By G. WHALEN.

Dairying, maize and cattle raising form the background to the working activities of the Mid North Coast. Five short rapid rivers each with an alluvial plain, separated by rugged hills and bordered by a high plateau and the wide Pacific Ocean, are the setting. Here, living in widely spaced farms and concentrated towns, some 35,000 people work out their destinies. Although distant from the million people of Sydney, they are yet closely linked in progressive development and in present day profits on their fields.

The Mid North Coast region extends from the Manning River to the Bellinger River in the North and inland a distance of some 50 miles. It comprises the lower valleys of the Macleay and Manning Rivers and the whole of the valleys of the Hastings, Nambucca and Bellinger Rivers. On the east it is bounded by the Pacific Ocean, on the north by the edge of the Dorrigo Plateau and on the west by the New England Plateau. In general the region slopes from west to east so that the contour lines run on a general direction parallel to the coast. The hundred foot contour line is the approximate boundary of the coastal plain. In the north a spur from the New England range forms the southern edge of the Dorrigo Plateau and reaches the sea at Coffs Harbour, attaining its greatest height of 4180 feet at The Lookout. Between the Nambucca and Macleay Rivers, the Snowy Mountains (greatest height Point Lookout 5280 ft.) stretch parallel to the course of the latter, reaching the sea at Yarrahappinni. The Hasting Range forms the divide between the Macleay and Hastings Rivers. South of the latter occurs the Kerewong Range which is in reality the edge of the Comboyne Plateau. On the average the region varies from sea level to 3000 feet from east to west, and about 50 per cent. of it is below 1000 feet in height. Physically the region may be divided into three portions, (a) the coastal plain consisting chiefly of the alluvial plains of the rivers; (b) the undulating and hilly country with only narrow creek and river flats; (c) the elevated plateaux together with their rugged flanks.

The coastal plain is well defined stretching from north to south along the coast. In the north it narrows, and disappears at Coffs' Harbour but increases in size southward reaching its maximum width of twenty miles in the valley of the Macleay. The Nambucca and Bellinger Rivers have much smaller alluvial plains. South of the Macleay River, the plain again narrows.

being only half a mile wide at Crescent Head. Beyond this it extends in a strip about 5 miles wide, the landward side of which is occupied by several lakes, e.g., Lake Innes, Queen's and Watson Taylor Lakes. From John's River the coastal plain widens until the alluvial plain of the Manning River is reached and then diminishes towards Cape Hawke. With the undulating country is included the hilly country rising towards the New England Range and also the narrow alluvial flats along the headwaters of creeks and rivers. Under this term most of the region is placed. In height the land varies from 100 feet to 3000 feet, and reaches inland from the coastal plain towards the New England plateau. This country cannot be called rugged and will be useful when cleared, but in general the slopes are too steep to permit arable agriculture since the soil will be washed away. Near the rivers and streams, flats are numerous and it is here that the arable agriculture of the region will be developed in the future. These flats vary from a few yards to a mile in width and generally occur where the rivers or creeks make sweeping bends. These flats are comprised of rich alluvium and many are intensively cultivated although subject to floods which destroy many of the crops and wash away the best of the soil. Perhaps the best examples of these river flats occur in the Gloucester



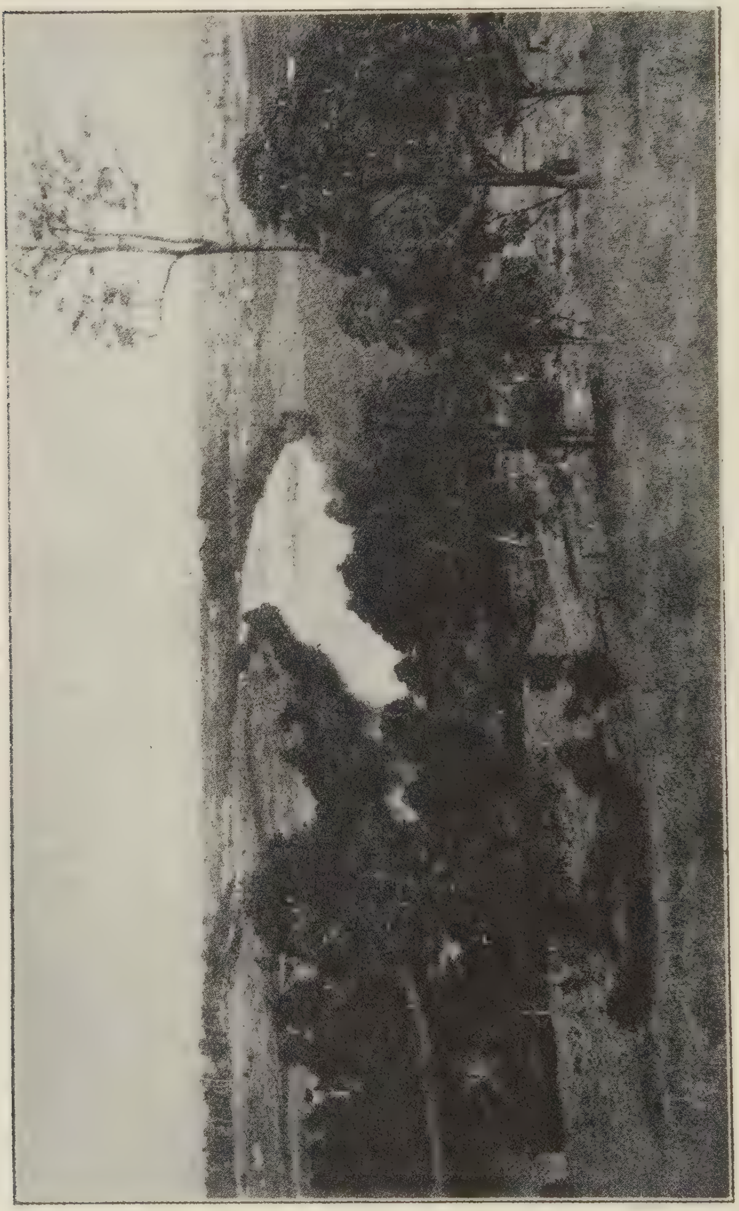
Approximate contours of the Mid North Coast.

District on the Avon and Gloucester Rivers. The type of hills varies within the region, much of the variation being due to the different rock structures. In the south near Gloucester long narrow ranges of porphyry with precipitous slopes, dominate the landscape. To the north and east of these the country consists of a monotonous jumble of rounded hills with wide intervening valleys which are generally dry. Since the soil is rather poor and the shape of the land and its clayey nature does not allow the rain to soak in, this part is devoted mainly to dairying and cattle raising. Between the Hastings and the Macleay Rivers the country becomes hilly rather than undulating and many of the creek and river flats tend to become "sour" and of little use for agriculture. North of the Macleay River the country becomes increasingly hilly with large amounts of white quartz pebbles in the soil, the river flats being the only level land.

The plateaux occur in the middle of the region just south of the Hastings River and with them will also be considered their rugged flanks or scarps. The plateaux are limited in extent, the Bulga and Comboyne being far the largest and in general elevation are about 1500 feet high. Many small streams have cut steep walled valleys into the plateaux, the chief being Dingo and Killabakh Creeks and Lansdowne River on the south and Stewarts and Camden Haven Rivers on the east. From the north the Ellenborough River and its tributaries together with the Thone River have succeeded in cutting huge gorges, the headward erosion as shown by numerous waterfalls, e.g., Ellenborough (highest in Australia) and Rawson Falls, has almost reached the southern edge of the plateaux, in places the divide being only a few yards wide.

The Comboyne and Bulga Plateaux are not level but with the exception of the river gorges resemble mature topography. The hills are dome shaped and are often completely ploughed over. They slope gently to flat floored valleys about 200 yards in width and are generally tilled. Throughout the plateaux hills consisting of hard undecomposed rock rise above the general level of the region. They are noticeable in another respect, namely the vegetation which covers them is in places the only available timber for miles, so ruthless has been the destruction of timber on suitable land. The Bulga Plateau is smaller in extent and at present more heavily timbered than the Comboyne Plateau. The flanks of the plateaux are so steep that at present they are useless for settlement so here the State Government has reserved huge areas of forest. The land between the two plateaux is very hilly and is mainly unsettled.

The drainage of the region can be regarded as characteristic of the normal cycle of erosion. It is drained by the Bellinger, Nambucca, Macleay, Hastings and Manning Rivers and their tributaries, together with many small coastal creeks and streams, all of which rise inland on the uplands and flow in a general easterly direction. The five major rivers are all navigable for some distance, but since the railway has been built, the river trade has declined to such an extent that regular sea trade is now confined to the Macleay and Manning Rivers. All communication by sea has been hindered by the presence of bars at the mouths of the rivers and these have caused immense damage as well as delay and inconvenience to shipping. During



THE MANNING RIVER AT TAREE
(By Courtesy of Govt. Printer, N.S.W.).

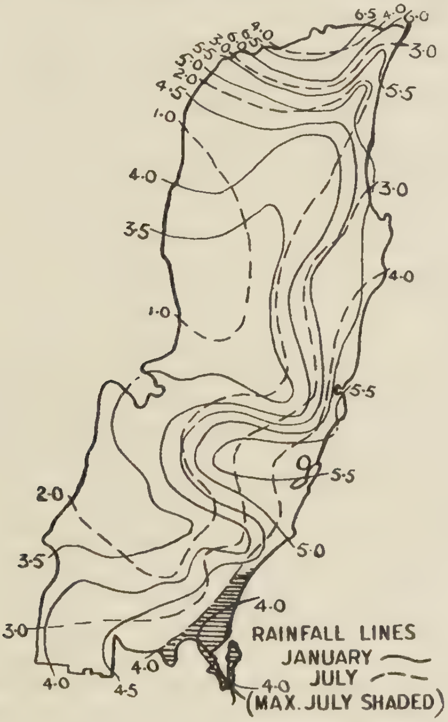
the early part of this century the Government has built training walls to keep the river mouths in one position and to facilitate the entrance by steamers. The chief drainage is by the Macleay and the Manning Rivers. The former is about 160 miles in length being second in size to the Clarence River on the North Coast and the latter is 150 miles long. The Macleay River receives all its larger tributaries outside the region under discussion, but within it receives numerous smaller streams which are important as the sites of present attempted settlement. All along the river are alluvial flats which are mainly used for maize growing. Near its mouth it receives the Belmore River which though insignificant in length, is important as a means of transport and is the centre of a rich district. The Macleay River is tidal to Greenhill where it leaves the hills to enter the plain. Although the chief tributaries are outside the region, their effect is often felt as a curse by the lower Macleay Valley. When heavy rains fall on the headwaters of these tributaries, floods occur destroying all the maize on the river flats and completely inundating the alluvial plain from Kempsey to the sea. Near the mouth the Macleay River spreads out into a large marshy area with flat sandy islands covered with mangroves. For 8 miles the river flowed due north along the coast being separated from the sea by a narrow sandspit. This resulted in such a poor entrance that navigation was well nigh prohibited and floods were a regular occurrence and of longer duration due to the damming action of the sandspit. In 1893 the Great June Flood pierced this sandspit at its southern end and this new entrance was protected with stone by the Government in 1906 at a cost of £86,000. This new entrance is safe for navigation and being direct allows flood waters to escape more easily. However, by allowing free entrance to the tides, it has permitted much of the lower land to be converted into mangrove swamps.

About 70 miles of the lower course of the Manning River lies within the region. Its largest tributaries are the Nowendoc River (rising in the Hastings Range), the Barnard River (rising in the Liverpool Range) on the north bank and the Gloucester River on its south bank. Nearer its mouth on the north bank it receives Dingo and Killibakh Creeks and the Lansdowne River, smaller, but important. Near Taree (the largest town on its banks) the river divides to form a delta with two entrances to the sea, Harrington Inlet on the north and Farquhar Inlet to the south. The former being the safest and having least sandbars is used by sea-going vessels. The delta consists of several islands, the chief being Oxley, Mitchell, Jones and Dumaresque Islands which are the sites of fine farms. The Manning River, like the Macleay has a large mountainous catchment area which results in floods on the coastal plains. The Bellinger River consists of two branches, the North and South Arms, the former being the larger and more important. The North Arm rises in the coastal range and flows directly to the sea being joined by the South Arm at the entrance. The drainage basin is very hilly country and the river has only a limited alluvial plain. The Nambucca River rises near the Snowy Mountains. It consists mainly of three branches, the chief of which is Taylor's Arm. The river is small and has a bad entrance which at present is almost silted up. It is often flooded quickly owing to its purely coastal character. The Hastings River is about 100 miles in length being larger than the Nambucca and Bellinger, but smaller than the Macleay or Manning Rivers. It rises in the Hastings Range which separates its basin from that of the Macleay River and flows south and then east entering the sea at Port Macquarie. Its chief tributaries are the Ellenborough and Thone Rivers on the south and the Wilson River on the north bank, the latter river being almost as large as the parent river. The lower reaches of both are largely swampy. The Hastings in relation to its size has only a small silt plain.

Besides the rivers named above there are several smaller independent rivers all of which flow into lakes near the coast. Between the Hastings and Manning Rivers, the Camden Haven and Stewarts Rivers rising in the Kerewong Range flow into Watson Taylor Lake. South of the Manning River, the Wollamba and Cooloongalook Rivers rising about 30 miles inland flow into Wallis Lake.

There are several lakes (more correctly lagoons) within the area, but all are more or less coastal. The largest is Wallis Lake about 25 sq. miles in area near the south of the region. It has an entrance to the sea near Tuncurry. Between the Hastings and Manning there are five other lakes, the largest being Lake Innes which is about 10 sq. miles in area, but is largely marshy. The swampy area forms a belt five miles wide extending along the coast from the north of the Bellinger River to the south of the Manning River. This swampy area is of two varieties: (a) The mangrove swamps in the deltas of rivers and at the mouths of the coastal streams are limited in number and never more than a few square miles in area. They are at present economically valueless as the land is inundated by the tides. (b) The true coastal swamps (by far the most extensive) extend right along the coast, reaching from the rear of the sand dunes inland towards the higher ground. These swamps are on the average about 3 feet above sea level but are prevented from draining to the sea by the line of sand dunes and being about at river level there is little tendency to drain towards the rivers. Besides, this tendency is prevented by the high river banks which, as in other alluvial regions, are the highest parts of the alluvial plain. Much of the swamp land has been reclaimed by digging canals or laying pipes through the high banks, and affixing flood gates which allow the water to run out but not in. Only the higher areas can be reclaimed in this way and indeed much will not pay for its reclaiming since it is of a very poor, sandy nature.

Climate.—The temperature of the region is rather mild, lacking generally the great extremes which occur on the western side of the New England Range. The average temperature is in the neighbourhood of 65 deg. F. (Pt. Macquarie 64.0 deg. F.) while the maximum mean is about 74 deg. F. and the minimum mean about 50 deg. F. (Pt. Macquarie 72.8 deg. F. and 55.2 deg. F. respectively). The isotherms are roughly U-shaped with the opening to the north. Snow is not experienced, but frosts are frequent, though not severe. These frosts are sufficient to prevent the growing of sugar cane, which is destroyed by frosts. During winter bitterly cold westerlies often blow across the New England Range from the interior and cause the lower temperatures experienced. The following table is the result of many year's records:—



Rainfall of the Mid North Coast.

Town	Altitude	Extremes		Frost	
		Maximum	Minimum	Earliest	Latest
Kempsey	18ft.	113°F.	21°F.	31st May	14th Sept.
Pt. Macquarie	44ft	105.5°F.	24.8°F.	6th June	5th Aug.
Taree	30ft.	111°F.	25°F.	24th April	26th Sept.

The region being on the eastern coast receives a fair average rainfall which is almost evenly distributed over the year, being greatest in January and February and least in September and October. The average rainfall is between 40 and 60 inches per year, but is rather erratic, varying as much as 50 inches from year to year. The rainfall is greatest near the coast and decreases inland with two exceptions (a) in the north the Dorrigo Plateau intercepting the rainbearing winds has caused the isohyets to run at right angles to the coast, (b) in the middle the Comboyne Plateau causes the isohyets to curve inland. There is often a great variation year by year from north to south in the region. During the early months of 1928 while the northern rivers Macleay and Nambucca were flooded, the Manning River was experiencing a drought, the intervening distance being only 60 miles. . This erratic nature of the rain is largely due to the downward surges of tropical loops which cause the torrential rain and floods in the region. Rainfall is the most important climatic factor for the whole region. The absolute amount of rainfall and the season of its fall is not of so much moment as the rate of fall. The coastal plain and the river flats are the most important parts and it is these that suffer from the devastating floods which do more damage than years of drought.

Town	Av. Rainfall.	Av. No. rainy days
Pt. Macquarie	61 inches ..	132 days.
Taree	45 ,, ..	104 ,,
Wingham	42 ,, ..	72 ,,

The region with a maximum in July extends from Manning Heads inland towards the Hunter Valley. So well is the region watered that the question of water supply for people or animals is only of minor importance. All the larger towns have their own water supply drawn from the neighbouring river. Throughout the remainder of the area the drinking water is caught in iron tanks off iron roofs. On the coastal plain where fresh surface water is scarce, cattle are watered by means of shallow wells 10 to 15 feet deep tapping the groundwater which in wet weather is often within a foot of the surface. These wells have generally permanent water. Inland in the hilly regions owing to the topography wells are not used but often there is an abundance of natural streams which are often dammed by weirs. Failing this, artificial dams are constructed in dry valleys by building a barrier of logs and earth across the end of the valley and after rain this conserves the water which otherwise would run off. There is no need for irrigation anywhere in the region.

With such a climate it is not surprising to find the region largely forested and less than 50 per cent. is at present deforested. Most of the rugged country is still covered with huge timber which is too inaccessible to be commercially valuable at present while the level country has been shorn of its mill timber and the remainder destroyed by ruthless ringbarking and burning. On the more rugged country such as the edge of the Kerewong Range with its heavy rainfall, the land is covered with a semi-tropical forest. Everywhere vines, creepers, ferns, and other undergrowth combine with huge timber, trees covered with moss, stag-horns, orchids, and other parasitic plants, to form an almost impenetrable mass. At the present time the State Government has reserved large areas for state forests in the region, the chief of which are Lorne, Nulla-Fiveday, Kerewong, and Dingo State Forests. Reafforestation is not in practice as yet, but thinning and improving the present forests is being done. The chief timbers in these forests are hardwoods, e.g., Ironbark, Tallowwood, Blackbutt, Mahogany, and several kinds of gum and box. On the edges of the State forests, especially near the railway, many small sawmills are situated, is fact there is a sawmill in almost every town, and several in the larger towns. These sawmills are the pioneers of settlement and many of the towns owe their establishment to the presence of a sawmill. The ruins of sawmills can be seen in many parts of the coast where the timber has been cut out. In 1929, 9,180,000 cubic feet of hardwood, about 46% of the State's hardwood timber production was obtained in the region. Most of the trade is with Sydney. Much of the alluvial coastal plain is treeless, a heritage of the time when maize growing was the chief industry of the place and trees were not required. Now because shade is required for dairying, thousands of coral and willow trees have been planted for this purpose. The same kinds of trees are being planted in avenues and along fences to prevent floodwash. The majority of the flat swampy area near the coast is covered with grass trees and tea-trees while the river banks are clothed with willows and casuarinas. The native grasses are chiefly blady, kangaroo and blue grass and these cover most of the hilly country which has been ringbarked or cleared. On the coastal plain the imported grasses of paspalum and clover have entirely replaced the natural grasses. Their advent was one of the chief causes for the increase in importance of the dairying industry in the region.

The Dairying Industry

The pride of place among the industries of the region must be given to the Dairying Industry. The chief products are butter and cheese and to a smaller extent condensed and dried milk. The following table shows the quality of butter and cheese produced in the region.

Year		Total Butter Produced		Total Cheese (Macleay District only)
1907	..	6,806,000 lbs.	..	17 lbs.
1912	..	10,585,000 ,,	..	144,000 ,,
1917	..	11,421,000 ,,	..	1,032,744 ,,
1922	..	15,156,000 ,,	..	1,237,000 ,,
1927	..	19,013,000 ,,	..	1,320,509 ,,

The Macleay River is the only producer of cheese in the region, and produced over 18% of the total output for N.S.W.

The region also produces 18% of butter production of N.S.W. From the above table the percentage increase in butter production during the twenty year period 1907-1927 in the region was 18% while for the same period the increase in N.S.W. production was 67%.

The increase in the dairying industry is also shown by the increase in the number of milch cows within the region. The salient points are contained in the following table.

	Milch Cows in Thousands						% increase 1908-28
Year	1908	1912	1916	1920	1924	1928	
Macleay (including Nambucca & Bellingen)	20	30	24	25	32	35	75%
Manning ..	22	29	13	20	25	29	32%

NOTE: The decline in 1916 is due to a severe drought in 1915 and 1916.

During the same period 1908-1928 the increase in N.S.W. was only 8%.

There are seven reasons why Dairying is the chief industry: (1) it pays the best; (2) it is the surest payer; (3) it is a continuous payer; (4) the other rival industry, maize growing, has only a local Australian demand for its product, and if the crop is large, the prices are too low for an adequate return; (5) there is a sufficient supply of fairly cheap labour, moreover the farmer can employ his family milking; (6) the climate is such that all the year round grazing can be carried on and shelter sheds are not required; (7) the introduction of paspalum and clover in place of the native grasses has led to improved pastures. This last has been done principally on the coastal plain where the moisture is sufficient, since paspalum or clover will not flourish on dry hilly country, e.g., in the Gloucester district where the native grasses are the chief pastures even now. The map shows the distribution and number of milch cows The most noticeable fact is that much of the dairying is carried on in separate localities which correspond exceedingly closely to the river valleys with the exception of the Comboyne and Bulga Plateaux. The map also shows the predominance of the dairying industry in the Manning River District.

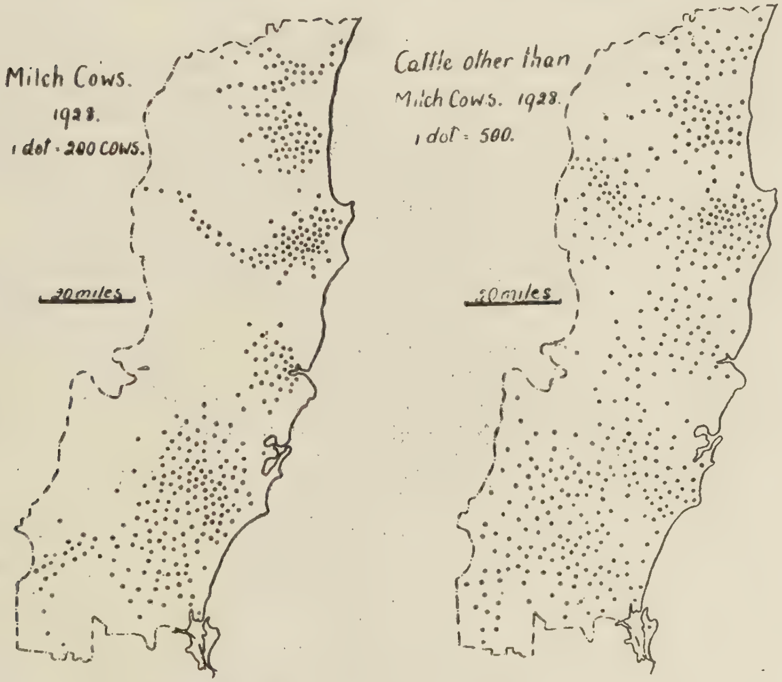
In 1928 the number of cows in the different districts were:—

Macleay River District	17,115
Nambucca " "	12,545
Hastings " "	10,922
Bellinger " "	7,205
Manning " "	30,394
Total for region ..	78,181

Altogether the region has one-seventh of the total number of milch cows in N.S.W.

The future of the dairying industry in the region seems to be full of promise. At the present time the dairy farmers are awakening to the knowledge that scientific farming pays in the long run. The Government now employs herd testers, who for a fee of 5/- per cow, will test the butter making capacities of the cows. In this way the poor class of cow is being replaced in the herds. This is the first step towards improved herds of greater output.

The resources of the region are far from being exhausted; with a little effort and a greater concentration on the conservation of fodder the output of dairy products could be doubled. With maize growing the reverse appears to be the case, it appears that the total maize yield will continue to decrease in the future. Maize will grow in ringbarked or steeply sloping fields where it may be planted by digging a hole with a hoe and dropping the seed in by hand. However, the yield of maize per acre strongly reflcts the amount of cultivation. Maize requires a rich soil and the alluvial river flats are excellent in this respect. Besides giving a large yield of grain maize is the staple summer green fodder for the region and the stalks after harvests and the husks are of some value as a winter fodder. Maize also requires a long growing season both warm and moist. These conditions are closely fulfilled by the region which has a



Note concentration of Milch Cows in Valleys.

good summer rainfall and a long hot season. Maize cannot stand frost and this sets the southern limit for maize growing. It is also very shallow rooted and thus requires intense cultivation to bring the rich soil up to the roots. In many parts of the coastal plain where dairying is also carried on, the maize is planted immediately after the saccaline or wheat (the winter fodder) is used up. This does not permit a large amount of cultivation so the yield is correspondingly low. This is one reason why the regions of greatest average yield per acre are inland where the limited alluvial flats are used almost exclusively for maize growing and where dairying is not so important.

The Macleay and Clarence are the first places to send their crops to the Sydney Market. The first planting is generally about the beginning of August to catch the higher prices which prevail at the beginning of the season, namely, about January. This crop is often a failure since the North Coast has a dry spring. Within the region the time of planting for the chief crop is September to November. Maize as a crop makes a great demand on the plant food in the soil and after it has been grown for several years in the one field the yield is considerably lowered. This is another reason why the coastal plain which has been used for maize growing for many years has a lower average yield per acre than the alluvial flats of the inland portion, which are relatively new. Maize grain cannot be stored efficiently for long since it is attacked by the grain weevil which destroys it and thus maize must be marketed at once, a decided drawback to the industry, since it results in a glut in the market at harvest time and a scarcity afterwards.

Maize is the most important crop in the region and is extensively grown, especially on the coastal alluvial plain and the river flats inland. It is grown as a crop chiefly in the upper portions of the valleys of the Macleay, Nambucca and Hastings Rivers. The coastal parts are generally too moist for maize or are used for intensive dairying, the cultivated land being used for growing fodder. This last applies especially to the Manning Valley.

Production of Maize, 1928

Shire	Area Cultivated	Total Yield	Average Yield
Nambucca	3,562 acres	110,750 bus.	31.0 bus. per acre
Macleay	9,432 ,,	368,288 ,,	39.0 ,, ,, ,,
Hastings	5,503 ,,	184,746 ,,	33.6 ,, ,, ,,
Manning	6,673 ,,	222,513 ,,	33.4 ,, ,, ,,
Total	25,174 ,,	886,257 ,,	34.5 ,, ,, ,,
N.S. Wales	148,801 ,,	3,930,570 ,,	26.4 ,, ,, ,,

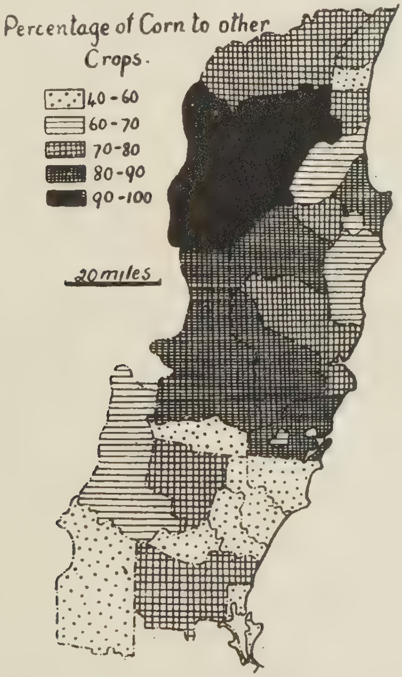
The state of the maize industry can be judged from the following table:—

MAIZE: Area Cultivated (thousand acres).

Year ..	1908	1912	1916	1920	1924	1928	%decrease
Macleay P. district	25	25	21	15	14	14	44% „
Manning P.	10	9	10	7	7	9	10% „

MAIZE: Total Yield (thousand bushels)

Year ..	1908	1912	1916	1920	1924	1928	%decrease
Macleay P. district	1000	975	660	611	617	532	47% „
Manning P. district	323	366	281	260	280	246	24% „



Percentage of total crop land in each Shire given over to cultivation of Maize.

The tables show that the maize industry has declined to a very large extent. While the total area under maize in New South Wales 1908-28 has declined 18%, in the Macleay and Manning Police Districts it has declined 44% and 10% respectively. It is a very significant fact that while in the two districts the area under maize has decreased 44% and 10% that the corresponding yields have dropped 47% and 24%, which fact points strongly to decrease in soil richness.

Maize has only a local Australian demand, the present demand being small and the competition of about one million bushels of South African grain per year has sufficed to make maize growing rather a precarious occupation. The future of maize lies in the plan of raising pigs and cattle on maize as is the practice in the U.S.A. corn belt region. At present the poor demand for pigs and the extensive cattle lands make this a non-paying proposition.

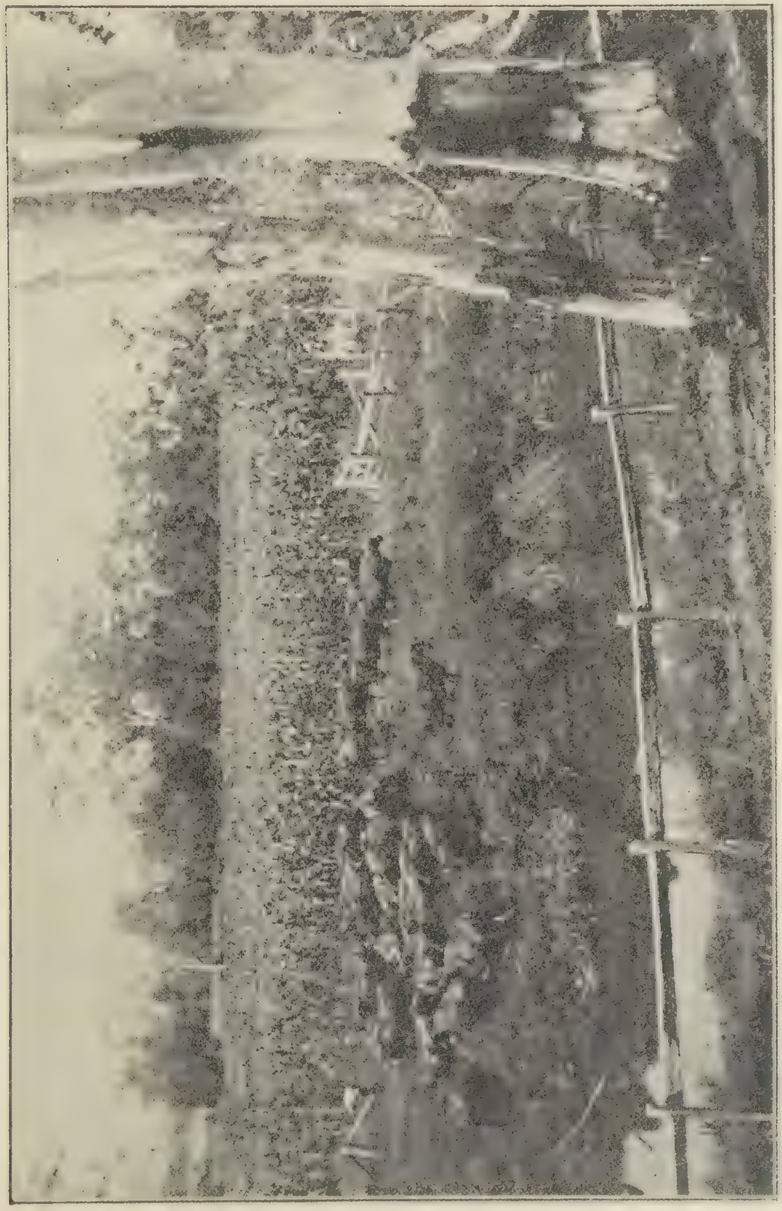
At present the main cattle lands are the areas which are unsuitable for maize or dairying on account of the ruggedness of the country, the thick forests, the swampy nature or poorness of the soil. The following table shows the progress of the industry within the region.

CATTLE: Number in thousands							Increase
Year	1908	1912	1916	1920	1924	1928	1908-28
Macleay P. District ..	77	93	97	118	83	104	35%
Manning P. District ..	70	84	54	124	83	89	27%

The number of cattle is far from being constant varying with the demand and the weather conditions. Cattle first supply the local demand and the remainder are shipped to Sydney markets. Most of the fluctuations in numbers are due, however, to rainfall, e.g., note the effects of the 1915-16 and 1924 droughts. The map of the approximate distribution of cattle shows that while more than 50% are in the same region as the milch cows, the remainder are scattered throughout the region, partly on leased crown lands, and on private property. The region in the accessible parts is too thickly populated to permit large holdings. No efforts whatsoever have been made to improve the breed and generally the cattle are nondescript mixtures. Pests and diseases are remarkably absent. The industry should increase in the future, but probably will not, since when the land is fit to carry one beast to about 10 to 20 acres, the tendency will be to start dairying which pays so much better than cattle raising, and for which there is sufficient labour available. Although much maize is grown in the region, it is not used locally for fattening cattle as in the maize belt of U.S.A. It is on the adoption by the farmers of the plan of feeding stock on maize that the future of both maize growing and stock raising depend to a large extent. It pays in U.S.A. now, but it would not pay in the region at the present time since the average price for maize is about £5 to £8 per acre per year and stock raising does not pay this amount per year.

A typical cycle of operations on the coastal plain is (1) maize (2) saccaline, (3) oats or wheat, the ground being under crop the whole year, and not allowed to fallow. Further inland where maize, not dairying, is most important, the ground is permitted to lie fallow during the winter. Speaking generally, the agriculture is carried out now in the same way as it was

20 or more years ago. There is no attempt to improve the methods, although a few farmers plough with tractors. The land is sufficiently valuable to warrant intense scientific agriculture, farms having been sold for £135 per acre. Having noted the decrease in the area under maize, it is not surprising to find a similar decrease in the area of cultivated land and this is partly the case.



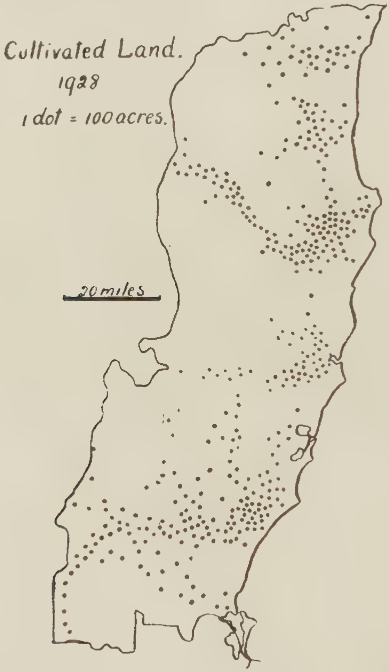
A NORTH COAST DAIRY HERD AND MAIZE FIELD.
—By Courtesy of Govt. Printer, N.S.W.

AREA OF CULTIVATED LAND IN THOUSAND ACRES

Year	1908	1912	1916	1920	1924	1928	
Macleay P. District	26	26	22	18	18	18	31% decrease
Manning P. District	14	13	13	12	14	14	7% increase.

During the same period 1908-28 cultivated land in New South Wales increased by 123%.

During the last few years there has begun a movement toward the use of artificial manures, especially superphosphate, the result of which soon will make it used throughout the whole region both on rich and poor land. "Grow more green fodder" ought to be the slogan of the whole coastal industry. At the present time the farmers do not grow nearly sufficient fodder for their needs. One of the great winter fodder crops is saccaline, a species of sorghum. It will grow on poorer ground and in drier conditions than maize, and will, when fully grown, withstand frosts unlike maize. In the region it is supplementary to maize, being planted chiefly in January and is thus ready for use during the winter, when maize would be destroyed by frost. The other main fodder crops, besides maize and saccaline,



Cultivated areas on the Mid North Coast. (Note the importance of the riverine lands).

are wheat and oats, which are mostly sown in the winter to provide spring crop. Maize as a fodder is sown thicker than maize for crop and may be cut when required or chopped and stored away in silos.

A feature which is noticeable of the whole agriculture of the region is the entire absence of any attempt to prevent soil wash. Slopes of 10 to 20 degs. under cultivation are common while in exceptional cases slopes of 30° can be found. The effect of the usually torrential rains on such unprotected slopes can easily be perceived in the numerous small water trenches all over the field. In parts of U.S.A. slopes of even 5 degs. are protected by means of cross furrow trenching so we must look forward to this method being employed in the region. But probably a large amount of sloping cultivated fields will be destroyed by soil wash before the people realise something should be done.

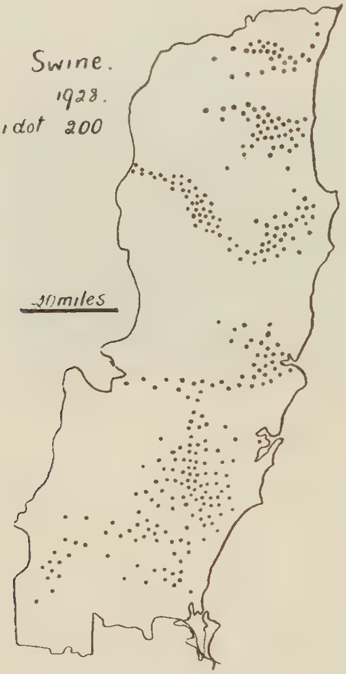
View of country near Gloucester. Clearings in middle distance are under maize and saccaline.

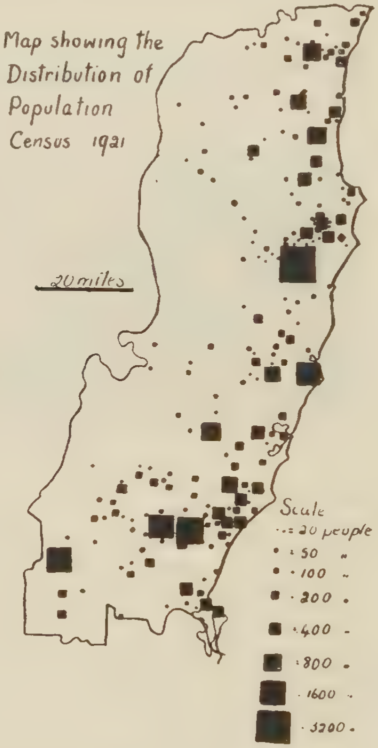
At present the breeding of swine in the region is only a secondary industry dependent on dairying, although the region has 21% of the total number of swine in New South Wales. If the dairying industry increases, the number of swine increases in general.

	SWINE: Number in thousands						Increase
Year	1908	1912	1916	1920	1924	1928	1908-28
Macleay P. District ..	12	22	19	16	26	29	140%
Manning P. District ..	10	17	14	12	17	21	110%

The above table shows that the number has increased over 100% since 1908, a greater increase than that of milch cows for the same period. For the whole of New South Wales the increase of swine was only 40%. The chief food for the swine is waste dairy products such as separated milk, whey, etc. It does not, at present, pay to add maize liberally to the diet of swine as maize is, on the average, 4/- per bushel, but as often as dear as 10/- per bushel. The swine are reared in small enclosures and there is no type like the razorback of the U.S.A. cotton belt, since the natural forests are deficient in nuts and will not support swine. The swine are generally sent to the Sydney market or made into bacon at factories which are generally co-operative concerns owned by the farmers, and generally run in conjunction with the butter factory.

Having seen the decreasing amount of agriculture and knowing of the increase of motor power for transport, a decline in the number of horses would be expected.





HORSES: Number in Thousands.

Year ..	1908	1912	1916	1920	1924	1928	%decrease
Macleay P. District	11	12	13	12	11	8	27% "
Manning P. District	9	11	12	11	10	9	0% "

Most of these horses are employed in tilling small areas of cultivation on dairy farms, etc., which will not pay for an introduction of motor power on account of their limited extent. The remainder are used as beasts of burden in the more hilly country where motor transport at present is impracticable. In the future the number of horses will pobably continue to decrease in the region, but very slowly.

The distribution of the population is influenced by the topography of the area in that the majority of the population is distributed over the coastal plain, while the hilly country inland is almost unsettled; the majority of the population on the coastal plain is settled in the river basins. This is not unexpected seeing that the industries are most strongly developed near the coast as shown above. There are two exceptions, i.e., the Gloucester and the Comboyne areas which are not on the coastal plain. The former is situated in the fertile valley at the junction of the Gloucester and Avon Rivers, and also on the main road and rail route to the North Coast. The latter is the centre of the rich agricultural lands of the Comboyne Plateau. It is interesting to note that Pt. Macquarie is the only large town in the Mid North Coast on the sea coast, but it owes its position to historical factors, being founded as a convict settlement by Governor Macquarie. It is the oldest town in the area. The other large towns are at the head of navigation of the respective rivers, i.e., where the hills meet the plain. Kempsey, the largest town in the region is situated at the head of navigation of the Macleay River. In 1921 its population was 3609 people, 10% of the total population of the Mid North Coast. At present it is increasing at the greatest rate of any large town in the region. Taree, the second largest town is the centre of the Manning coastal plain, but, unlike Kempsey, has very little inland trade, this being done by Wingham, its rival, at the head of navigation of the Manning, 7 miles away. The other towns of importance are Bellingen on the Bellinger River, Bowraville and Macksville on the Nambucca River, Wauchope on the Hastings River.

The increase in population was greatest from 1861 to 1911 during which period there was a continued influx of immigrants, who settled on the suitable lands. At the beginning of this century all the accessible good land had been settled, so the influx stopped to a large extent, and since then the population has mostly grown by natural increase.

The rate of increase of alienated land also shows a marked decline in the rate of settlement since 1912. This does not mean that the region has reached the end of its resources, but that it is passing from an era of active settlement to one of active development. Each year the increasing intensity of the dairying industry, aided by maize and cattle raising, makes the future of the region more secure and full of promise. In every way the Mid North Coast appears destined to become one of the richest portions of the Australian coast lands.

The Geographic Background to Town Planning*

By J. MACDONALD HOLMES

One of the earliest records of the appellation "town" occurs in the pre-Romano-British word "tun." A "tun" was merely a meeting place—a gathering ground of the tribes when they came down from the neighbouring hills. No doubt this idea of a town arose to mark the place of common usage. To-day in the bushlands of Australia a crossroads is of no small significance. The modern city is a meeting place and of a most multitudinous complexity of interests. In the early days there was little to mark the "tun." It was an open space capable of accommodating a crowd and there was the maximum flexibility in its spaciousness for any orientation of that crowd. To-day our towns are much more static—buildings, streets, industry, finance and people are set to hold rigidly to "a local habitation and a name."

To visualise any different reorientation of our buildings, streets, residential suburbs, etc., requires considerable mental courage because of long-standing familiarity with apparently rigid conditions, while the pragmatic application of the ideas engendered brings forward strong opposition from the forces of inertia. Yet if historic records have any utility in these matters it is this primeval fundamental quality of flexibility which is most worthy of preservation in our cities. Much of the joy of travel in old countries comes from the remarkable difference in the structure and appearance of the towns and villages at short stages on the journey. This diversity arises fom the fact that towns grow up in response to the needs of the surrounding country. The woollen towns of Yorkshire for example, are elongated by the streams high up in the hills. A site on the bank was of value in the domestic industry. The agricultural towns in Northern Italy and in Spain are congested and constrained so as to leave as much land for agriculture as possible. To spread the **unproductive** houses over the land is waste, so the labourer walks in some cases five miles or more to his work in the fields. The Arab sets his house on the waste of sand so as to preserve the very limited moist area around the oasis for his date palms; thereby he also preserves his means of livelihood. The bulb and vegetable farmer of the Low Countries who must grow his crops in spite of the weather has a township of glassed-in conservatories, and his acreage is extensive. The domestic cotton industry of Germany and the pre-industrial revolution textile towns of England covered proportionally immense areas because each stream had its alignments of houses, mills, and fields. The change in the industry from domestic to factory conditions changed the whole aspect, economy and distribution of the house, streets, factories of the towns. The terraced vine-clad slopes of the Rhine and their strictly placed villages at their base, or the paddy fields, tea gardens, and overcrowded streets of the communal units in Japan are each in delicate equilibrium. Any hasty changes in the spread of the **unproductive** household units decreases the **productive** units and introduces possible starvation. Then, the industrial towns place their mine shafts, cleaning process plants, blast furnaces, railway sidings, and the houses of the workers in some relation each to the other for successful operation. Similarly, there is the oil town with its derricks and storage tanks or the gold-mining town hurriedly put together and as hurriedly abandoned. The permanency of the agricultural towns is in contrast to the temporary character of the industrial towns. Many towns have taken their design from the needs of defence. There is the perched town of Durham, its castle built on a hill against the Scots; or the walled city of Jerusalem. The church has been instrumental in bringing people into settled communities. Perhaps the earliest examples were the cities of Babylon—planned rectangularly for the better worship of the passage of the Sacred Image. To this day the early purpose of the church town is visible in the dominating architectural feature of the Cathedral and the slumdom congested around its door, and the roads radiating from it. Perhaps the greatest force which operates to produce a town is trade. Under modern conditions this force has made large cities possible. It may be trade in cattle as in the stockades of Chicago or the river and sea trade of Rotterdam. It may be the cosmopolitan oceanic trade of Sydney or of Liverpool. New towns have "sprung up" lately in the form of health and tourist resorts and in meeting the needs of modern transport, airports have been formed.

---

*A lantern lecture delivered before Society 11th March, 1930. The slides showed many examples of town types and plans and also summarised what was being done in many other cities.

These are the forces which in the early days operated singly and produced characteristic townships. To-day they operate just as effectively but usually in combination so that a large city contains many elements which are the resultant of all these forces.

It follows then, that there is a better or a worse way of distributing the material objects which are the response of these primeval interests, and also in making provision for such newer needs as recreation places, parks, etc.

Modern cities are so gigantic in size that their many magnitudes defy cohesion, though it is cohesion which makes city life tolerable. There may be a living and homogeneous entity of cultural, social and commercial effort or merely a heterogeneous assemblage of buildings, vehicles, individuals and streets. The proper distribution of these latter has been shown from the earliest of times to affect materially the greatness of the former. Maldistribution of the material things of a city places an enormous mortgage upon effort. It takes the form of disproportionately heavy taxation, loss of time, inefficient operation of buildings with diminution of health and contentment; and a general feeling of exasperation prejudicial to harmonious living. Disunity may be so great as to prohibit material prosperity and fail to provide citizens with the necessary leisure which is the prelude to cultural attainments, scientific research and the general accumulation and full use of knowledge—things which are a measuring rod of national greatness.

In the early days when everyone was directly concerned with land, town and country distributions organised themselves by the discipline of the facts. Under modern industrial conditions of wage-earning classes arbitrary decisions and expediency take the place of organisation. Yet from the earliest of times it has been generally felt that plans were necessary. The general appreciation has lagged behind industrial development, however, and it is only in more recent years that great strides have been taken.

Two factors have always been in controversy. Often a geometrical plan was made in "the office" and imposed upon any site regardless of its suitability. More rarely all the factors in the site were allowed to modify that plan before it was carried out. The Babylonian or the Roman imposed a rectangular plan upon a site often without any regard to suitability or its ultimate value. (The walls of a Roman town are an after feature to meet the change from a civil occupation to individual military defence when the frontier walls failed to give protection.)

The Roman in Britain was succeeded by the Saxon who took full advantage of regions which lend themselves to natural defence. Many an old world city is cramped in its growth because of this feature in its location. Shrewsbury, for example, is built upon an almost circular loop in a small river. The persistence of this town because of its early start has made it a nodal point with four or five trunk routes converging upon it, but the traffic congestion through the old town is a resultant of the early choice in the site.

The Royal mile in Edinburgh (from Castle to Royal Palace) is a further example of a historic development due to the utilisation of the isolated hill and "dip slope" as a defence feature.

Many of the medieval plans suggest a return to the geometric design. The chief feature in Danzig for example, was the zig-zag of water or moat round the city. Under modern conditions the water zone proved a disadvantage since the city has grown so great as to leave the moat in a central position. By filling in the moat which had been a disadvantage and under growth of public appreciation, it can now be used for parks, etc., and gives breathing spaces in the city's congested areas. In many American cities the strictly rectangular plan, usually attributed to Penn, was imposed upon many cities. In some parts of Australia that plan is still characteristic. As civic sense is growing and the geographic setting in town formation is becoming valued, new reorientations are taking place. Much of the reconstruction of Chicago and Washington is typical of this appreciation.

More recently New Delhi and Canberra, which are entirely new towns built for specific purposes and without a history, have been designed to take full advantage of a site. There may be controversy about the scale of these towns and the fact that the development will be long and protracted due to the geographic factors in the situation, but from the point of view of site appreciation and designing, they epitomise the history of planning since the earliest of times.

In summary, then, the Romans made arbitrary decisions in town construction; the Saxon chose his site and moulded his town afterwards, the medieval and the early American plans reverted to arbitrary considerations, while the most modern plans take full advantage of all the factors in the site and the interests concerned.

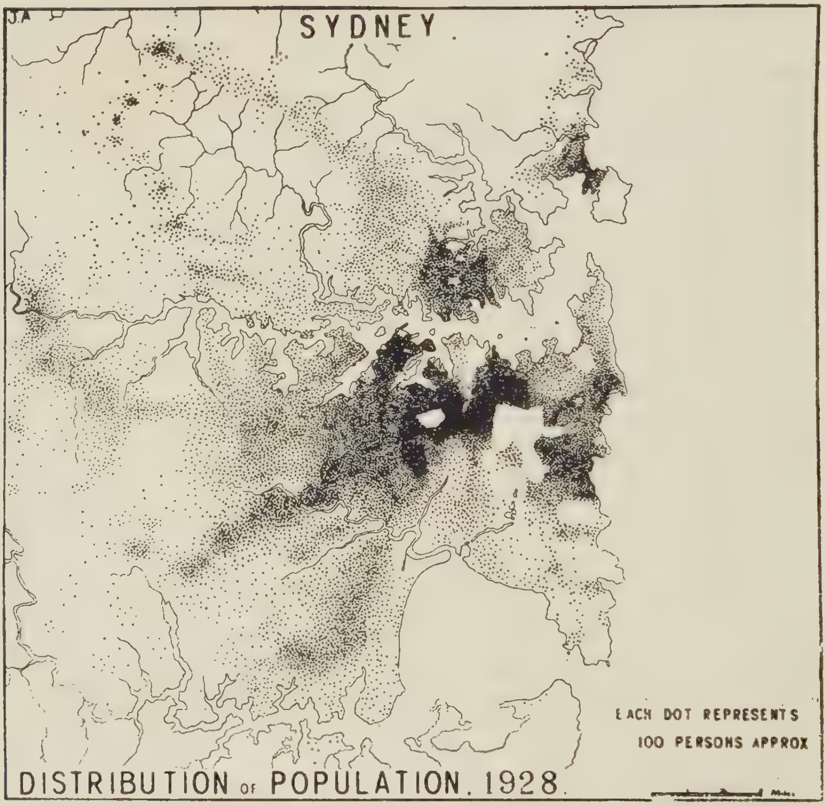
Of such is the background to city growth and all modern cities have to face it in whole or in part. Everyone is agreed that change is desirable—all cities require reorientation. With our present knowledge an entirely new city could be built but our life blood lies in the old. A trading and commercial city cannot be built in the beginning, it must grow and show its tendencies. Since the response to the geographic factors must be allowed to make themselves felt it means that each generation has to undertake some part in reorientation—in rebuilding the city. Absolute static conditions mean deterioration and retrogression; whilst the maintenance of flexibility allows of growth. Public spirit and a demand for better environment for the citizens in their immediate neighbourhood in conjunction with the growth of wealth in a city have meant an increased desire in planning for improved material standards in the attributes of living.

Town planning is not a new business. In ancient Egypt, in Greece and in Rome there were town planners. Edward I. in England and later Napoleon in France founded new planned towns. Craig in Edinburgh, Grainger in Newcastle and the Society of Friends in Leitchworth and elsewhere are more modern examples. Germany and Sweden have town planning departments in their civic administrations. In England there has been town planning legislation since 1909 and in 1923 it was decreed that all towns with a population of over 20,000 had to prepare, by 1929, a town plan of future developments.

India, China, Japan have planning arrangements in some form or other.

In Australia much has been done. Brisbane has a town planner, Sydney a regional town planning convention and Melbourne a town planning commission. The Straits Settlement has a town planning department attached to its government. In U.S.A. there are extensive departments connected with town planning.

A city may be considered as a region of empty spaces, such as streets and parks; and full spaces such as industrial buildings and residential houses. The chief problem is the concentration of the full spaces and the chief danger is congestion. It is often felt that there is a lack of space but congestion is due rather to the wrong distribution of space. The chief object of planning is the proper allocation of space so as to maintain the orderly, healthy, and efficient development of the community concerned. Town aggregations obtain for economic reasons, most of which are concerned with industry and marketing. Standardised production has improved communication so that phenomena may be widely spread. Building construction, improved sanitation and water supply have made possible close

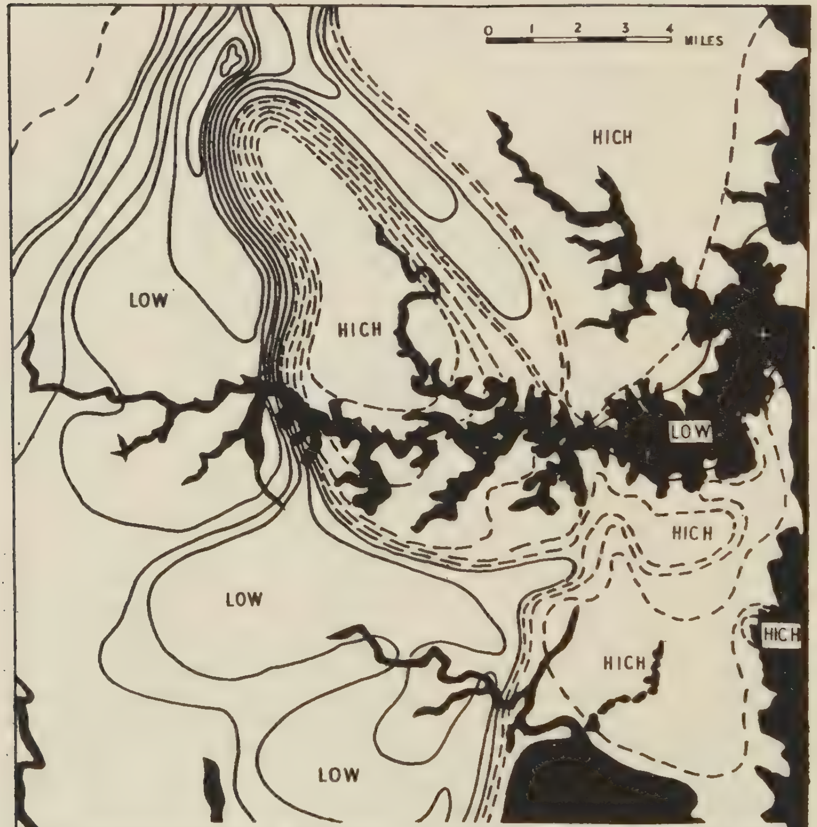


DISTRIBUTION OF POPULATION, 1928.

concentration such as obtains in the skyscraper. Arterial highways, fast speedways and rapid transport facilities have made it possible for residential or dormitory suburbs to be remote from the industrial centre or shopping district.

For these reasons the central region of most cities has changed entirely. What was formerly residential has now become commercial centres since head offices of warehouses, banks, shipping and newspaper offices must of necessity be together. The residential aspects have moved out to the new ground beyond. Sydney is no exception and the point is emphasised by the dot map where the centre has few dots while the suburbs show as a concatenation of grouped dots. It is clear that shopping blocks and theatres ought not to be competing for the same stance as warehouses or factories with bulk products to handle. The problems are endless however, because of their greatness. For example, industry must be situated in relation to the factors which favour its growth, its own predetermined and prospective needs and its service to the community. Competition between industry and residential sights for the harbour frontage might meet with ordered discussion to mutual advantage. Further, there is the locating of residential buildings to areas which are the most beautiful and are in proximity to working centres and sport and recreation facilities.

The great questions of traffic organisation, so pressing in every city, are not capable of being solved solely by so called regulating the traffic. The city must deal with small quantities and distribute a few persons in the shortest possible time. For that sort of traffic it is possible that the trams are unexcelled. But there is the peak hour traffic out to the suburbs, when large numbers have to be dealt with in a short time, and for that it would seem the service bus and the limited stop bus or electric train are the most efficient. Then there is the heavy traffic. In the old days all traffic came through the city, now, it is not desirable to take traffic through the city if it does not particularly want to go there—by-pass routes and alternative routes are part solution of this traffic. Further solution lies in evening up the traffic by all different routes, and it is obvious that the solution lies in the proper location of the sites between which the traffic travels. Fast motor traffic, slow horse traffic and fixed route traffic—i.e., trams and trains—have each their space distribution in the individual streets and crossings. The problems cannot be elaborated here, but the degree of accessibility of the varying suburbs in Sydney are set out on the ischronomalous chart below. It will be remembered that the western districts are served by trains, while the eastern districts have the electric trams. Buses travel to various suburbs, but their operations are considerably restricted. An isochronomalous chart consists of lines joining all points of time anomaly. Time anomaly is the difference between the time taken to any given point if the rate of speed was the average for all vehicles in the city and the actual time taken to the point. Low anomaly suggests easy accessibility, while high anomaly suggests difficult accessibility. The pattern of these lines is very suggestive. From the point of view of time the more remote western suburbs generally are more accessible than the much nearer eastern ones. Manly, too, due to the echelon structure of the harbour fronts, is much nearer than Vaucluse. To take away the "inaccessible" regions, new circular routes will be required. For example, circular bus traffic routes would greatly facilitate matters in these regions. The general pattern of human activity is distinctly based on geographic factors in the greater Sydney district.



ISOCHRONOMALOUS LINES FOR SYDNEY.

Note: I am indebted to Mr. J. Andrews for the use of the map of the population of Sydney.

Dairy Production in New South Wales 1924-25

By C. D. J. BACK

This map was constructed for the year 1924-25 owing to the fact that the yields of dairy products for that year were very high, and thereby offer the best presentation of the industry's distribution. This good season was in part a result of the heavy rainfall which occurred in the coastal districts.

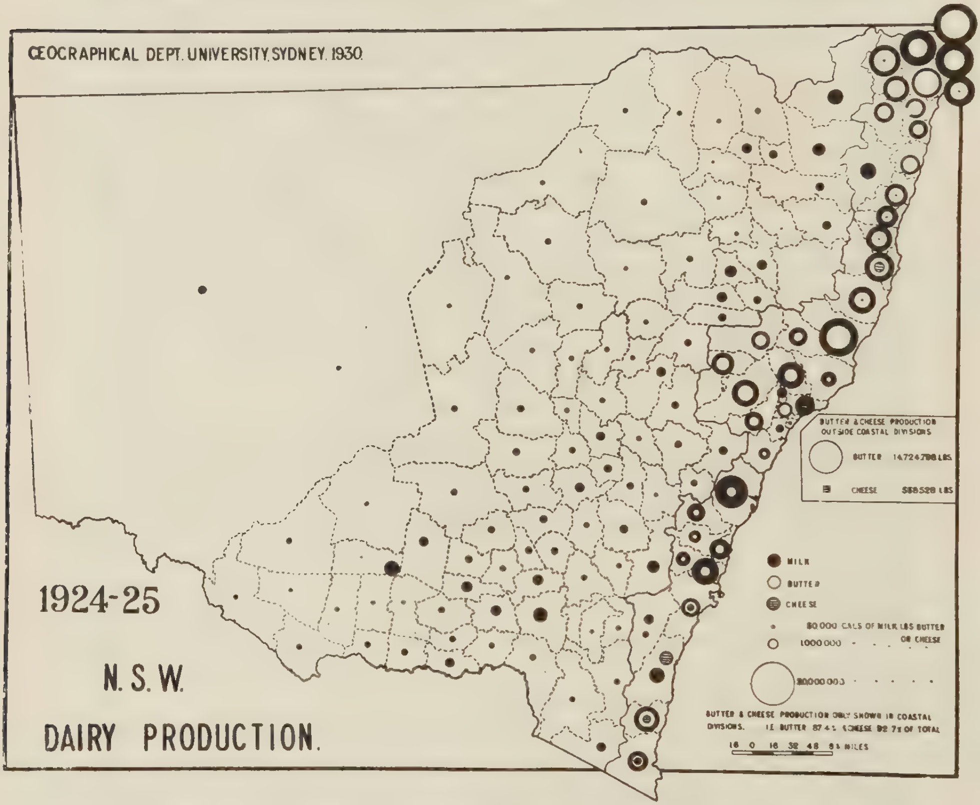
The broken lines on the map represent shire boundaries, and in the centre of each division was placed a circle of area proportional to the total milk production of the shire and the municipalities contained therein. Butter and cheese production are shown only for the coastal division, the western boundary of which is shown by a continuous black line. The relative unimportance of these products in the rest of the State is indicated by the fact that for the year ending 30th June, 1925, the coastal division was responsible for 87% of the butter and 93% of the cheese production of New South Wales.

The soil and climate of the coastal district are suitable for the dairying industry with a minimum of expense and labour, and, owing to the abundant rainfall and the mildness of the climate, housing and hand-feeding of the animals are unnecessary. The dominance of this region in the dairying industry may be seen when it is realised that 85% of the milk production in New South Wales comes from this part of the State. The coastal dairying region extends inland for a large distance in the Hunter River valley, as the fertile alluvial flats there are very suitable for this industry.

Formerly the centre of greatest production was on the south coast, originally in the Illawarra district, but gradually it extended further south. The greatest width of the coastal plain along the north coast was an important factor in making the northern part of the coastal district the chief dairying region, and in 1924-25 the total yield of milk on the north coast was 3.4 times as great as that on the south coast. All along the north coast many large estates used previously for raising cattle for beef have been subdivided into dairy farms, but the far north coast, in the area drained by the Tweed and Richmond Rivers, is the centre of greatest production, the region being one of heavy rainfall and fertile basalt soil supporting a large population.

More than half of the butter in the State is made in the north coast division. The Hunter and Manning division is next in importance, then the south coast, followed by the south-western slopes, where the dairying industry is becoming increasingly important, particularly in the area near Tumut.

The manufacture of cheese is small compared with that of butter, probably because cheese represents little more than half the money value of butter for the same weight, although the cost of freight is practically the same. More than half of the total cheese output is made in the south coastal districts, the greatest amount being produced in the Eurobodalla Shire.


GEOGRAPHICAL DEPT. UNIVERSITY. SYDNEY. 1930.
1924-25
N.S.W.
DAIRY PRODUCTION.
BUTTER & CHEESE PRODUCTION OUTSIDE COASTAL DIVISIONS
BUTTER 14724708 LBS
CHEESE 558520 LBS
MILK
BUTTER
CHEESE
80,000 GALS OF MILK LBS BUTTER OR CHEESE
1000 000
20000 000
BUTTER & CHEESE PRODUCTION ONLY SHOWN IN COASTAL DIVISIONS. I.E. BUTTER 87·4% CHEESE 92·7% OF TOTAL
16 0 16 32 48 64 MILES

The Macleay district is the only part of the north coast where cheese production is at all large.

In the drier inland regions of New South Wales, the area of dairying land is not extensive, as fodder must be grown for winter food. The frequent droughts in these parts do not favour dairying. Beyond the limits of shire boundaries dairying is practically impossible. This is indicated by the fact that the Western Division produces only one-third ot one per cent of the milk of the State.

The areas of greatest production of butter and cheese lie in the far north and south coasts respectively, that is far from the regions of dense population near Sydney and Newcastle, as, unlike milk, these products are able to stand transport over a relatively large distance. Near the centres of large population, however, dairy farming is undertaken to supply local needs, most of the milk being used as such, and not being made into butter or cheese. In the other part of the State milk production is so small that it is all needed for local use.

(The figures on which this map, and that relating to population were based, were obtained from the New South Wales Statistical Register.)

Population Density in New South Wales, 1921

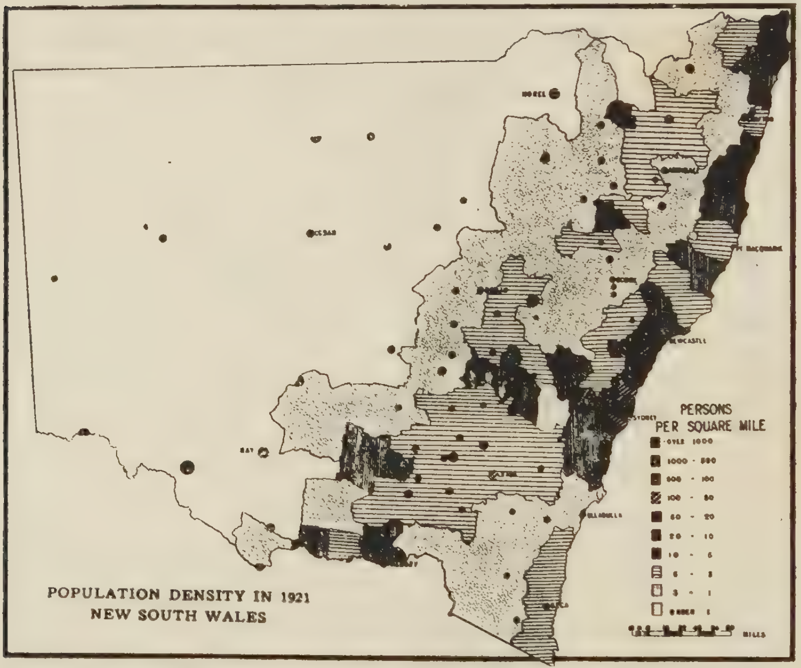
C. D. J. BACK

Owing to the fact that the population of each municipality in New South Wales is very much denser than that of the rest of the shire, it is necessary, in the making of a population map, to consider the municipalities as separate units, and in the accompanying map their population is shown by means of circles. Most of the large towns of the State are incorporated as municipalities, and the division into municipalities and shires may be considered to represent approximately the division into urban and rural elements respectively, the incorporated urban districts containing more than two-thirds of the inhabitants of the State.

The importance of representing the towns as areas of close settlement separated by regions where the population density is low may be seen when traversing any part of New South Wales. The most striking feature is the way in which, after travelling miles without seeing any sign of human habitation, one suddenly comes upon a country town with a large population. A specific instance of this change from a region of scattered settlement to one of dense population is provided to the west of the Blue Mountains, in the shires of Blaxland and Turon, which contain the municipalities of Lithgow and Bathurst respectively. The density of population in Blaxland shire is about eight per square mile, while that in the Lithgow municipality is 2029 per square mile. Similarly, Turon Shire has a density of five, and Bathurst municipality one of 2362 per square mile.

The great difference between the density of the Blaxland shire and that of the Lithgow municipality is the result of the importance of mining in that town, so that in the case of Lithgow, as also in Broken Hill, there are special circumstances for this difference. In the mining districts along the coast and in the Hunter River valley the townships are not separated by regions of such sparse settlement, and conurbation is occurring; this is indicated on the map by larger areas of dense settlement than those in the inland mining districts.

The population of the metropolis represents more than two-fifths of the population of the State, since less than one-quarter of the inhabitants are found in country municipalities, and less than one-third in the remaining rural districts; but, even apart from this large concentration in urban centres, the whole State shows an uneven distribution of population. If an average figure is taken for the density of each of the five major statistical divisions, a considerable variation is indicated by them.



POPULATION DENSITY IN 1921
NEW SOUTH WALES

The coast is by far the most thickly settled region, the density here being 44 persons per square mile. This is due to the fact that, apart from the metropolis, the most densely populated regions of the State are those of the northern and southern coalfields. There is also a large population in the dairying districts; particularly in the extreme north.

To the west of the coastal district, and much more sparsely settled than it, lie the tablelands, where the density is only six per square mile. In the coastal districts, since the areas which are occupied are usually small and intensely cultivated, they are able to support a large population; but on the tablelands small holdings are rarer, as the land suited for intensive farming is more scattered, thus giving a smaller and more widely distributed population than along the coast.

The slopes which lie to the west of the tablelands are regions of sparser population, the density here being only four per square mile. As in the tablelands, the central part of the western slopes is the most densely populated.

In the western plains and Riverina district lies a region of still more scattered settlement, where the density is only two per square mile, while in the region beyond the limits of shire boundaries this figure falls to one per two square miles, over half of the people in the Western Division being found at Broken Hill. In eastern New South Wales, the rugged nature of the country in the New England, Blue Mountain, and Kosciusko plateaux has formed a barrier to settlement, but in the west this barrier has been climatic, the only important settlements within the region where the rainfall is less than 20ins. in the north, and less than 15ins. in the south being found along the Murray and Darling Rivers, and at Broken Hill. The map must suffice for further illustration.

"TEA" TREE, NOT "TI" TREE

Readers of the papers in this number of the *Australian Geographer*, will note two places in which the TEA TREES are referred to. These are trees of the genera *Melaleuca* and *Leptospermum*, well known in the coastal districts of eastern Australia. Though the popular name is often rendered as "TI" Tree, the editor desires to draw particular attention to the error which is thus made. Notwithstanding the frequency with which public correction has been made in various places, the error still persists. It seems to be about as difficult to correct as is the mis-spelling of the name of the fish, SNAPPER, so often wrongly rendered as "Schnapper"—for which there is no justification whatever.

The Tea-Trees were so called because Captain Cook's men, while in New Zealand, actually made a kind of tea beverage (a very poor substitute, of course) from the leaves of a kind of *Leptospermum*. There is actually a Ti Tree in New Zealand, but this is a species quite distinctive and not a native of Australia.

In Cook's "Voyage Towards the South Pole" appears the first reference to these Tea Trees. Here it is stated that the leaves were used for the making of a "tea"—he calls it the "tea plant," that being the name given by the men on the former voyage. They were also mixed with a decoction of so-called "spruce" leaves in the making of beer!—(Ed.)

Port Kembla and its Harbour

By E. A. CRAGO and A. G. LOWNDES.

Situated on the South Coast just south of Wollongong, about 45 nautical miles from Sydney and 58 miles by rail, is the new artificial harbour of Port Kembla.

Topography.—The Illawarra coastal plain, which widens from the North, is five miles wide from Port Kembla to Mount Kembla, which, with Mount Keira, stands out as a prominent land mark. Immediately to the south, behind Lake Illawarra, the coastal plain is nine miles wide. However, the general mature surface of the coastal plain is broken here by a ridge averaging 200ft. high, and reaching 375ft. in Flagstaff Hill. This is due to the resistance of the Dapto-Saddleback lava flow, which, issuing from a point to the east of Port Kembla, flowed to the west until it reached Unanderra, and then flowed S.S.W., ("Memoir on the Geology and Mineral Resources of the Southern Coalfield"—Harper). The ridge has rounded features with steep, but undissected slopes, which are well covered with good grass, mainly paspalum. A few fodder crops are grown on this ridge on the gentler slopes, but it is evident that it forms excellent grazing ground, as does the rest of the coastal plain away from the swamps, and there are some good dairies located on the ridge.

On the hills surrounding the works of Australian Iron and Steel, Ltd., some of the original bush has been left undisturbed. There is a beautiful covering of grass, with dense clumps of timber and thick undergrowth similar to the brush on the foothills of the scarp. This forms a contrast with most of the privately owned land, which is bare of timber. Though Port Kembla township is sheltered to some extent by the hill, it has the reputation of being a bleak town, and this is partly because there is no forest obstruction to the bitter westerlies coming from the plateau. On the north and south sides of Port Kembla are situated Tom Thumb Lagoon and Lake Illawarra. These are both shallow, and their low-lying shores are swampy and covered with ragged tea-tree, casuarinas and eucalypts. In their present condition these lagoons are obstructions to easy communication, and restrict settlement. The South Coast road has been diverted around the western side of Lake Illawarra, and then it has to come back again to the coast. This means a big deviation, and is a handicap to Port Kembla, which thus becomes a dead-end as far as through road-traffic is concerned. It has been proposed to build a road along the sandspit enclosing Lake Illawarra, and to build a bridge across the Lake Entrance.

The entrances to both these lagoons are at the southern extremites owing to the direction of the along-shore current from north to south. The influence of this current is also seen elsewhere. Since the construction of the northern breakwater, the littoral drift has piled up sand along its northern side. Again, going from the eastern breakwater to Red Point, two main bays in the Headland are passed. In both of these bays there is a sandy beach stretching from the northern end towards the south, but this beach does not occupy the whole of the bay, for the southern third is composed of a small shingle beach and rock platforms awash at high tide. This may be due to the sand being deposited in the lee of the points and the extensive rock platforms on the points. These would divert the littoral drift, and then where its influence again reached the shore small debris would be carried away, leaving the rock platforms bare, and the rock waste may have been torn off the platforms by storm waves.

The ridge which has been discussed before is only 100 feet high behind the township, but rises again to give a conspicuous hill 235 feet high on Red Point. This hill has steep sides, and although composed of the Dapto flow, it is covered with wind-blown sand which has been partly consolidated, and no outcrops of the country rock are seen. On the east it falls rapidly to near sea-level, and then there is a smaller hill, 120 feet high, on the extreme end of Red Point. Stretching from here to the islands off the Point is a shallow reef. The headland is covered with honeysuckle and low trees, and is only inhabited by a few aborigines and their families, who live in humpies, and are probably descendants of the big tribes which have left considerable deposits of shells in the kitchen middens seen on the Point, and, in fact, right along the coast. Rock platforms are quite considerable on Red Point. They are mainly eroded in the tuffs upon which the Dapto flow rests, and occur at levels which are too high above the sea to be accounted for without a recent small uplift. There are at least six volcanic dykes to be seen on the rock platforms. They have the usual appearance of ridges across the platform, or are seen in long channels which the sea has eroded between the hardened rocks on either side.

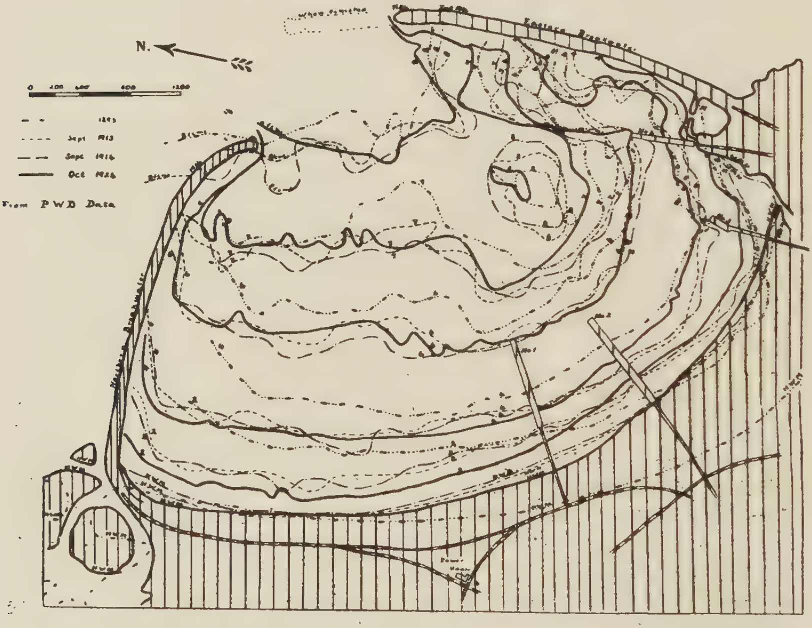
The sandspit which encloses Lake Illawarra is 3½ miles long, and varies in width between one mile and half a mile. The ocean side is covered with a level beach, and then big sand-dunes which are thickly wooded a couple of hundred yards inland. The western side of the spit is flat, is almost at sea-level, and represents the filled-in part of the lake. This ground is often swampy. Residents say that the wooded part (which has been declared a timber reserve) once extended much closer to the sea, and while walking among the sand-dunes, an old tree-stump often sticks up out of a hollow 100 feet from the present limit of the timber. In America, stronger currents and more constant winds have given an advance of sand-dunes at the rate of 30 feet per year, and, although the speed is not nearly as great here, the dunes are evidently encroaching on the forest quite rapidly.

Some natural protection from southerly winds is afforded by the projection of the Point, three of the Five Islands, and a reef connected with them to the south. However, the main protection is given by two artificial breakwaters, and this is one of the few examples in Australia, where it has been necessary to construct an artificial port. The reason is that the rich Illawarra Coast plain has a linear shoreline with an absence of inlets. The northern breakwater extends almost due east from the beach, and is 3263 feet long and 19 feet above low water. The eastern breakwater points northwards, and, when finished, will measure 3,750 feet, though at present it is still incomplete, and, as it has to stand up to the heaviest waves, it is 23½ feet above low water. The final width of the entrance will be 1000 feet, with a minimum depth of 30 feet. The breakwaters are of massive construction, stones weighing from 4 to 30 tons being used. When completed they should need little maintenance work, although at present a heavy storm may sweep 30 feet off the end of the unfinished eastern wall. The anchorage

PORT KEMBLA.

HARBOUR DEPTHS.

NOTE THE CHANGE IN DEPTH SINCE THE BUILDING OF THE BREAKWATERS.



in the harbour is good, as the blue-clay bottom gives good holding for anchors.

There was some discussion about the plan of the breakwaters, but, in the one finally decided upon, the eastern overlaps the northern breakwater. To increase the overlap, and also add strength, they are curved slightly inwards. The width across the top is 15 feet, and there is a concrete capping with a railway line, which caries the tipping-trucks bringing rock from the nearby quarries. By the construction of the breakwaters, it is now possible to load and unload cargo at Port Kembla when standing signals are flying at other ports along the coast, and the harbour is naturally sheltered from all winds except from the north-east and east. Because of the harbour dues, ships, while waiting to berth, frequently wait outside the harbour, and this has given rise to a rumour that the Port is not safe in a big storm. However, only a couple of vessels have ever been moved by a storm while anchored in the port. At times the waves break over the eastern wall, but have not much power left afterwards. There is ample mooring-room for the largest vessels, 144 acres having a greater depth than 36 feet at low water spring tides, out of a total area of 340 acres. It is interesting to note the effect the building of the breakwaters has had on the harbour depths. A map, given herewith, shows the depths in April, 1895, September, 1913, September, 1914, and October, 1924. On the whole, the harbour has been deepened, which is not what one would expect at first. This may be due to part of the water from the north-south littoral drift entering the harbour and eddying round, and so scouring out the floor of the Port, and there is no stream to deposit silt. In 1924 it is noticeable that the harbour has shallowed slightly alongside the eastern breakwater, but there was little other change since 1914.

At present the berthing accommodation consists of four jetties, which are numbered from the north. No. 1 has a berthing length of 806 feet, and is used for coal alone, almost any size vessel being able to be loaded at a very rapid rate by a conveyor-belt plant. No. 2 has been recently rebuilt for Australian Iron and Steel, Ltd., and is efficiently equipped, mainly for handling iron ore. No. 3 jetty is 982 feet long, and is equipped with gantry hopper and shoot arrangements suitable for loading coal and coke on the typical collier and coasting vessels. No. 4 jetty is 500 feet long, and is equipped with travelling cranes for handling general cargo. Between this jetty and the eastern breakwater is a small enclosure used as a boat harbour for launches and fishing boats.

The details of the shipping for 1928-29:—

	Arrivals.	Net Regd. Tonnage.
Overseas	162	546785
Coastal	183	40551
Interstate	181	247403
Totals	526	834739

The figures for the following year are similar.

Projected Works.—In the future, increased industries and shipping of raw products after the completion of the Moss Vale-Port Kembla railway, will probably necessitate more wharfage than exists at present, and there are several schemes. The first one provides for the building of a new jetty alongside the northern breakwater. This would save the waste jetty of the other piers before deep water is reached, because the line would run along the breakwater, and, although this would only give a one-sided wharf, the cost would be favourable. There is still room for the building of other piers similar to the present ones. Another scheme provides for the duplicating of the present machinery on No. 1 coal-loading jetty.

The third scheme is much bigger than the others, and is to make an inner harbour of Tom Thumb Lagoon, opening into the main harbour just south of the northern breakwater. Tom Thumb would have to be dredged, a retaining wall built around it, and the silt from the bottom would be used for filling-in purposes. The new harbour is to be 20 feet deep, 8,338 feet long, and 1500 feet wide. It is to be somewhat the shape of a boomerang, and the north end will almost reach to the town of Wollongong. Wharves about 300 feet long are to project obliquely from each side, and will be connected to a system of railway sidings. The present road to Wollongong, which crosses the north end of Tom Thumb, will cross the entrance to the Inner Harbour by a Bascule Bridge. The plan involves about 28 new wharves, and the land reclaimed will be used for factories and bulk stores. Docks such as this are common in the other cities of the world, although the necessity for them has not yet arisen in Australia. The plan seems quite good, and, although it may not be carried out for many years, the suitability of the conditions and the demand should lead to its completion.

Factors Governing the Location of Port Kembla.—There was a jetty at Port Kembla belonging to the Southern Coal Company, and used for the shipping of coal before 1895. The history of Port Kembla really begins, however, when the Electrolytic Refining and Smelting Works were established there in 1907. The choice of Port Kembla as the site of this industry was not a haphazard affair, but it is an example of the considered planting of a centre in the place offering the greatest number of geographical and economical advantages. The E.R. & S. Works deal chiefly in copper, and, though at the time they were mainly interested in Mt. Morgan mines, they had hopes of treating all the copper produced in Australia at some future date. The factors they had to consider in deciding on the site of the works were as follows:—(1) Closeness to supplies of coal suitable for using in the smelting of the copper; (2) a central position with respect to the copper mines then being worked at Mt. Morgan and Cloncurry (Queensland), Mt. Lyell (Tas.), Cobar, Mt. Hope, and Mt. Royal (N.S.W.), and Wallaroo-Moonta (S.A.); (3) a central position as regards the population of Australia, so as to be handy to the market; (4) proximity to the sea at a place capable of being developed into a safe harbour at no great cost. Other factors were the existing communications, an adequate water supply, and cheap flat land suitable for factory sites.

Most of the coal in Australia is found in a strip down the eastern coast, and the most extensive deposits of good coal are in the three N.S.W. fields—Newcastle, Lithgow, and the South Coast. Lithgow was ruled out because of its distance from the coast. Newcastle and the South Coast were equally central with regard to the copper mines and the population, although Port Kembla is some 50 miles closer to Sydney and 150 miles closer to Melbourne than is Newcastle. Newcastle had the advantage of being an industrial centre which would be likely to absorb the refined metal, and also of having a port already developed. Port Kembla had cheaper land, part of it being too swampy for dairying, but suitable for factory sites after filling in, and part of it being uncleared. Another advantage lay in the fact that there was no industry on the South Coast at that time to absorb any of the coal mined, all of it being sent away, so that the mine owners would welcome a home market, and supply it with cheaper coal than could be obtained on the northern field. After considering these factors, the South Coast was decided on as the site of the new industry. It was located more particularly at Port Kembla because of the ease with which a safe port could be made there. The ridge of volcanic material, of which Red Point is one extremity, served as a protection from southerly winds and seas, as well as providing excellent material with which to build the breakwaters. The port was also quite close to the main South Coast railway, and a plenteous supply of fresh water was available in the Cordeaux Dam, already connected by a pipe line to Wollongong.

The Growth of the Town and Industries.—As stated before, Port Kembla began with the establishment of the E.R. & S. Works there in 1907. These works are the largest of their kind in the British Empire, and are capable of treating the whole of the copper ore mined in Australia. The ore is smelted and the copper cast into moulds, and then purified electrolytically in the tank house. Direct currect is necessary here, and they generate it themselves, supplying also the metal manufacturers and the fertilizer works. This firm imports blister copper, cathodes, ore, concentrated matter, scrap copper, and slimes to the value of nearly £800,000 per annum. Most of the refined copper goes to the Metal Manufacturers, Ltd., who make products that compete successfully in the markets of the world. This company was established by the E.R. & S. during the war, when it was difficult to get manufactured articles from Europe. The plant is very modern, some of the more expensive machines being the only ones of their kind in the Southern Hemisphere. They use brass, copper, and copper alloys, and aluminium, and make rods, wires, tubes, strip bars and telephone cables to the value of £900,000 per year. This firm, like the E.R. & S., had its greatest opportunities during the war, when its output was about 40,000 tons of copper per annum.

The E.R. & S. Works use a great deal of sulphuric acid in their tank house, so they established a large plant for the manufacture of sulphuric acid nearby, and used the surplus acid to make superphosphate. In this way the Australian Fertilizers Pty., Ltd., came into being as a subsidiary of the E.R. & S. The sulphur for the acid is almost all imported from Texas, about 8,000 tons being used annually. Unfortunately, there is very little ore in Australia containing sulphur suitable for making the acid, though a small amount of local iron pyrites is used, the residual iron oxide being used in the smelting works. The plant is capable of making 75 tons of 70 per cent. sulphuric acid daily. The phosphate rock comes mostly from Nauru and Ocean Islands, and about 40,000 tons are used annually. The process consists in treating the phosphate rock with the sulphuric acid to change the water-insoluble tri-calcium phosphate into water-soluble superphosphate. The superphosphate is stored in bulk and bagged and trucked when needed. The busy season is the first few months of the year, when the wheat is being sown. Then, on some days, as much as 1,000 tons is bagged and sent away, the annual export being just over 50,000 tons. The demand for this product is a growing one, as farmers everywhere are realising the advantages derived from the use of fertilizer with all kinds of crops.

Australian Iron and Steel, Ltd., have only recently (1927) established large and up-to-date works at Port Kembla. These works were built by Hoskins, Limited, whose Lithgow works were becoming out of date. They were faced with the alternative of extensive rebuilding or starting over again in a new place. Lithgow had the big disadvantage of being 100 miles from the coast, where the market is, and whence the raw materials come. Hoskins' reasons for transferring to Port Kembla were similar to those enumerated previously for the E.R. & S. works. They have ore deposits at Lithgow, Goulburn, Yampi Sound in N.W. Australia, and some in Tasmania. The Yampi Sound deposits are very pure hematite ore, containing 69% iron, 70% iron being chemically pure for this type of ore. It is right on the shore of a landlocked harbour with a depth of 30 ft. of water 200 ft. from the shore. They also hold big deposits of 99% pure limestone at Marulan, 67 miles from Port Kembla. The company has coal deposits at Lithgow, and has lately acquired some on the South Coast. After the works were built, two big English companies and another Australian one were included in the firm to form Australian Iron and Steel, Ltd. The plant was built here on condition that the Government connected Port Kembla with Moss Vale by railway, and this work is proceeding at present. The works include a blast furnace capable of treating 800 tons daily, and the plant has been laid out to ensure the greatest efficiency, while providing for the enlargement of the plant when necessary at some future date. The company has its own jetty for the handling of the ores, and this is connected by rail to the works.

The Ulladulla Silica and Fire Bricks Co., Ltd., manufactures a very high class fire brick for use in blast furnaces where they have to stand up to very high continuous temperatures. The bricks compare more than favourably with imported bricks from Germany, Britain, and the U.S.A., and this firm has shown considerable enterprise in the making of new patterns, 90 different moulds being used. The bricks are by nature rather fragile and do not stand much transport, hence the establishment of the industry at Port Kembla, where there is a local demand for them in the blast furnaces. The silica comes from Ulladulla.

At present a very large lime and cement works is being built at Port Kembla to use shells from the extensive deposits near Shellharbour. It will be one of the largest enterprises of its kind in the world when completed.

The power house at Port Kembla is run by the Public Works Department, and has become quite a big undertaking. It was originally built to supply power to the quarries, etc., while building the breakwaters, but it has since been greatly enlarged, and now supplies the towns along the coast from South Wollongong to Nowra, and west to Moss Vale and Mittagong, 48 miles away, as well as supplying surrounding industries and quarries, and the Avon and Cordeaux Dams. Being handy to the coalfields, the freight on the coal per ton is low (generally about 2/-), so they can use low-grade coal. Bunnerong power house at Sydney has to pay about four times the freight on its coal, and, as there is such a large amount of waste in low-grade coal, it pays them to use the best. Thus, whereas at Port Kembla they never pay more than 13/- per ton for coal, at Bunnerong they probably pay 28/- per ton. Of course, they get more out of a ton of coal at Bunnerong.

Imports and Exports.—At present the exports from Port Kembla in order of value are manufactured copper and brass, refined copper, coal (cargo and bunker), fertilizers, and iron and steel products. The last mentioned will probably increase in value. The total value of the exports in 1928-29 was £1,985,845, and in 1929-30 it was £2,369,356, the increase being mainly in coal owing to the coal-strike on the northern fields, and in copper and iron and steel products. Coal is brought from as far north as Helensburgh to Port Kembla,.and all the mines on the South Coast send coal to Port Kembla because of the loading facilities of the harbour. In 1928-29 the amounts of cargo and bunker coal were similar, and this is probably the normal relation. The increase in coal exported in 1929-30 was mainly in cargo coal, this being three times the amount of bunker coal. More coal was sent to Sydney and Melbourne manufacturers during the recent long strike. The imports are chiefly raw materials used in the copper and steel industries, and they total slightly more than one million tons per annum.

Egypt, The Sudan and The Suez

Lecture to the Geographical Society, September 9th, 1930.

J. MACDONALD HOLMES.

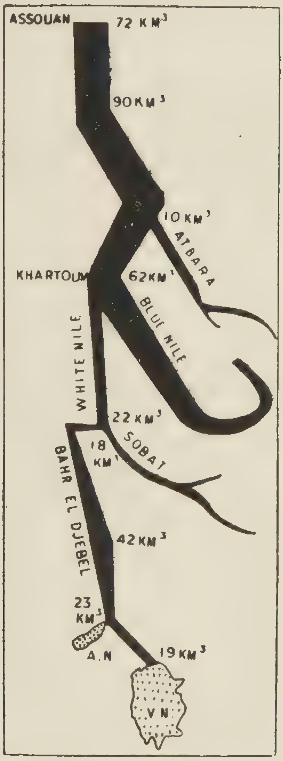
Australia is particularly interested in Egyptian affairs, since the Suez Canal, which passes through Egyptian territory, is the "via media" to Great Britain, and is one of the main communication lines of the Empire.

Since 1922 Egypt has been nominally an independent State, but, pending final agreement with Egypt, Great Britain reserves to her absolute discretion (1) the security of the communications of the British Empire (the Canal itself not being mentioned); (2) the defence of Egypt against foreign aggression and all foreign interference; (3) the protection of foreign interest in Egypt and protection of minorities; (4) the Sudan. Egypt is thus virtually a client State.

Since 1922 further discussions have taken place, notably that of 1929. The chief changes lie (1) in the agreement of Great Britain to remove her troops from Egypt, but to maintain troops on Egyptian soil east of meridian 32° and near to the Canal zone; (2) questions concerning the safety of foreign minorities; and (3) the readmission of Egyptian units into the Anglo-Egyptian Sudan.

There are few political problems of such magnitude which are so dependent upon the geographic background. Hence it is worth while for me to mention the salient facts in the geography of the three units under discussion. Egypt is an Oriental country accepting but not absorbing Western European civilisation and methods, and is governed by Europeans. Her ancient cities, which have great attractions for tourists, show evidences of Greek, Turkish, British, French and Mohammedan influences. In size, Egypt is greater than N.S.W., and about three times the area of the British Isles. Her population, mostly of Arab origin, is about 17 million. The foreign population is close on 200,000, of whom some 24,000 are British. Most of the foreign population are traders. (Great Britain has a population of 40 million, while N.S.W. has just over two million.)

Although Egypt is so large, over 14/15ths of it is desert, but there is about 10,000 square miles suitable for agriculture and to support this large population. The habitable area is spread out along the banks of the Nile. This large river is 4000 miles long (about equal to twice the distance from Sydney to Perth), and traverses both the Sudan and Egypt. It begins far south in Equatorial Africa at an altitude of about 4000 feet, amid the grandeur of great waterfalls and forest-clad mountains. The flood waters received from the July rains are carried northwards over the desert, but so great is the thirst of the desert that ere the Nile has gone half the distance to the sea its water-



Map 1.—Upper Nile drawn to scale to show volume of water. Note diminution of White Nile and flood volume of Blue Nile. (After De Martonne Geographie Physique.)

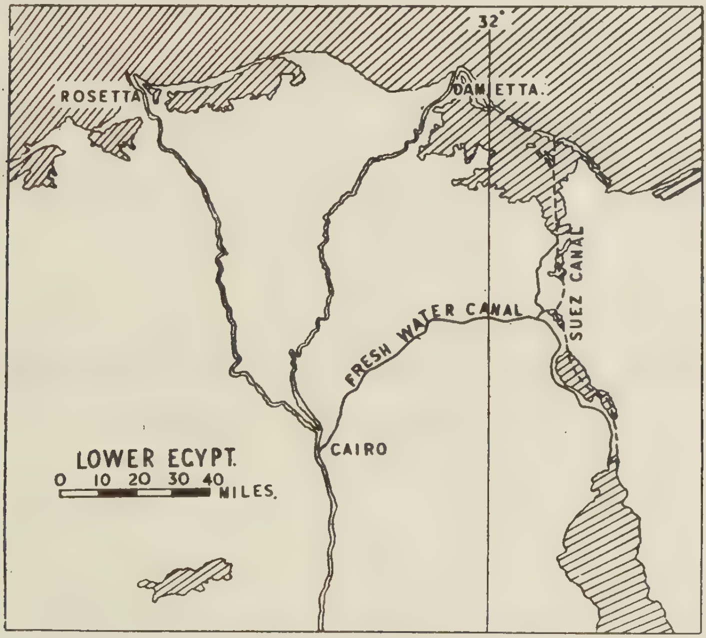
content is practically exhausted. At this point, near Khartoum, and 1500ft. above sea-level, the river receives its great tributary, the Blue Nile. The Blue Nile has started far in the mountains of Abyssinia, over 6000 ft. high, and received its water supply from August rains. It is the Blue Nile which brings the floods to the Nile. These floods are the life-blood of Egypt, and are eagerly awaited and prepared for. Regularly the Nile will rise 27ft. at Assuan; but if only 21ft. is registered there is a famine in Egypt. A rise of 30ft. is followed by disaster. Only four times in history have such irregularities taken place. The white Nile and the Blue Nile are in the Sudan. To the north lies Egypt, and practically throughout its desert course through that country the Nile receives no further tributaries. To gain control over the head-waters of the Nile, Egypt would gladly welcome sovereignty over the Sudan.

The flood waters and their contained mud are used for irrigation purposes. From the dawn of history until modern times the general method was merely to allow the water to flow the land. Unfortunately, the increase of cylic salts caused deterioration of the soil and crop failures. Modern methods under the supervision of British engineers, have built great dams across the Nile, and the water is led on to the land at stated intervals, and the residue drained off. This has meant a great extension of crop acreage and an increased security to Egyptian farmers. The fertilizing alluvium, however, has not been so widely available, and increased activity in agriculture has necessitated a general use of artificial fertilizers, which new necessary operations lend themselves to misinterpretation and unrest. Further, it has been said that the raising of the water in the dams has caused seepage, resulting in the raising of the water-table and the souring out of the deeper-rooted crops. One of the chief crops in Egypt is cotton. The type grown is a long-stapled type. Continuous cropping, however, tends to cause the plants to produce a short staple, and thereby reduce its value. So also does the souring of the roots cause the staple to deteriorate. Modern irrigation in Egypt has great triumphs and also some failures.

The Sudan, or the Country of the Blacks, is about one-fourth the size of Europe. It has a population of six million, mostly of negro origin. At one time its population was 8½ million, but during a period of Egyptian rule it was reduced to 2½ million. It is for this reason that the Sudanese do not desire Egyptian rule, though the Governor of the Sudan is appointed by Egypt under the supervision of Great Britain—hence the term Anglo-Egyptian Sudan.

The Sudan has a very healthy tropical climate, but only certain parts are fertile. The most important regions are the Island of Meroe and the Gezira, which are the regions between the Atbara and the Blue Nile and the Blue and White Niles respectively.

The Sudan controls the waters of the Nile. By agreement the flood water of the Blue Nile is allowed to pass on into Egypt, while the Sudanese only take water from the Nile when it is low. It is possible, however, that the increasing development of the Sudan may necessitate the use of the flood Nile, and thereby deprive Egypt. This great Sudanese asset is obviously of great concern to Egypt. To safeguard her water supplies, Egypt has been allowed to build a dam on the White Nile above Khartoum. In recent times the Sudan has greatly developed her trade in cotton, gum, hides, and copper. Great Britain takes most of the exports, and gives one-third of the imports. Formerly Sudanese trade went down the Nile and through Egypt, but the building of Port Sudan on the Red Sea has deprived Egypt of the trade. Here are two countries, by reason of their geographic circumstances, inherently linked together, yet in their development are divergent. The Sudan is seen to hold the key to Egypt, and therefore takes pride of place in political discussions.



Map 2.—Lower Egypt, Canal Zones, and meridian 32°E.

The Suez Canal is 100 miles long, and lies wholly in Egypt. The British Government owns seven-tenths of the shares, and appoints ten directors. The administration, however, is mainly French (for private interests), who appoint 21 directors, and the Dutch appoint one director.

The Canal is partly an artificially constructed channel through desert, and partly through a series of lakes. The whole surrounding country is desert in character, and the Canal is salt water. Along the western bank, however, a narrow fresh water canal has been constructed. It is by this means that railway stations and military barracks, etc., are maintained in the desert. The fresh water of the Canal comes from the Nile, via Cairo.

Of the traffic on the Canal Great Britain supplies 57%, France 6%, and Germany 10%. In 1875 Great Britain invested £4,000,000 in the Canal, and has been repaid some eight times.

Now it has been agreed that Great Britain should remove all her troops from Egypt and place them somewhere east of meridian 32°E. This move seems bad strategy, since it leaves the government of the fresh water canal, without which the Canal Zone could not be held, outside the control of the British. This magnificent gesture for peace in Egypt on the part of Great Britain would seem a surrender of the Canal and an endangering of the road to India and Australia. This may be so, but it is equally clear that the whole crux of these matters lies in the Sudan. Australia and the Sudan are closely linked to their mutual advantage.

Tropical and Sub-Tropical Agriculture in Coastal Queensland

By JOHN ANDREWS, B.A.

In the list of the world's crops, the products which go under the name of tropical products—sugar, rubber, coffee, tea, rice and sisal—occupy a not-unimportant position. While the area devoted to their cultivation is not large, and the total value of the production is small compared with that of the temperate grain crops, the list included some articles which the world could not well do without, and some which may be called important luxuries. While the demand for these products ensures a return which compensates for the often unfavourable and costly conditions of production, it is not at all certain that, in the case of the major articles at least, an extension of the producing area would give a uniformly beneficial result.

Queensland produces only one of the above articles in any significant quantity, namely, sugar. This crop has been grown under very artificial conditions with the aid of bounties and monopolies. The refined product is sold in Australia at a fixed minimum price; and the remainder, which, in 1928, comprised two-fifths of the total crop, is exported, mainly to the United Kingdom. Australia ranks with U.S.A. as the largest consumer of sugar per head of population. Again, since little beet sugar is grown in Australia, one readily understands the importance of the crop to Queensland. The table gives the actual value of production in 1928.

Production and Value of Production of Some Crops in Queensland in 1928.

Sugar-cane	3736311	tons	£7209778
Bananas	3265161	bunches	960000
Green Forage			812358
Maize	5135607	bushels	802439
Hay	85651	tons	453204
Pineapples	938335	doz.	225413
Cotton	12290910	lbs. unginned	213832

While individually not so important as cane-growing, the cultivation of some sub-tropical crops is important because of their collective value, and also because of certain facts in their geographical distribution. The crops dealt with in this article are the main crops of the east coast, and it will be shown that each has a very definite and distinct boundary. Queensland, indeed, shows a significant specialization in most of the main districts that is not evident in other agricultural lands of greater natural advantages or more intensive cultivation, and particularly is not found in the most important agricultural lands of all, the temperate grain lands. In the case of the U.S.A., only very small areas can compare with the Queensland coastal forms in devotion to one crop. Kansas, the principal State in the winter wheat region, has an average of half its land devoted to wheat, while the Dakotas, the spring wheat States, show 46% in the north and 25% in the south of their fields given to wheat-growing. In the wheat country east of the Rockies only one small area in the heart of Kansas has over 80% of its area under wheat. (Vide Russell Smith, "North America," p. 342.)

The following table shows the position in regard to Queensland, with certain crops added for comparison:—

Percentage of Crop Land under Various Crops in Queensland in 1928.

Division	Percentage of Land under						
	Cane	Maize	Cotton	Hay	Bananas	Grain Fodder	Pineapples
Moreton . .	3	37	.31	13	4	26	4
Wide Bay . .	33	27	1	3	6	17	.31
Port Curtis	9	7	64	3	2	4	.80
Edgecumbe	.96	.07	.01	.01	.25	.76	.25
Rockingham	81	16	.01	.05	.32	.85	.08
York	87	1	—	—	.68	.08	.05

This becomes more apparent when the subdivisions are considered instead of the large districts given above. The same facts are shown graphically in Fig. 1, where the variation of type of crop with latitude on the coast in shown. Speaking generally, then, tropical and sub-tropical products in Queensland are grown in a manner and with a method very different from that adopted in the agriculture of temperate lands, in so far as the main features of tropical agriculture are the specialisation of the farm (over large areas) in one crop; and the more primitive or less intensive method of cultivation as shown in smaller yields per acre when compared with those of more temperate areas, although in the latter the natural advantages for the particular crop are not so great. An example may be taken from the Tweed-Richmond-Clarence areas of N.S.W. in regard to cane. The N.S.W. areas, grown at the southern limits of cane cultivation, show an average production per acre over the years 1919-1928 of some 25 tons, while the Queensland areas for 1920-29 have an average of only 17 tons.

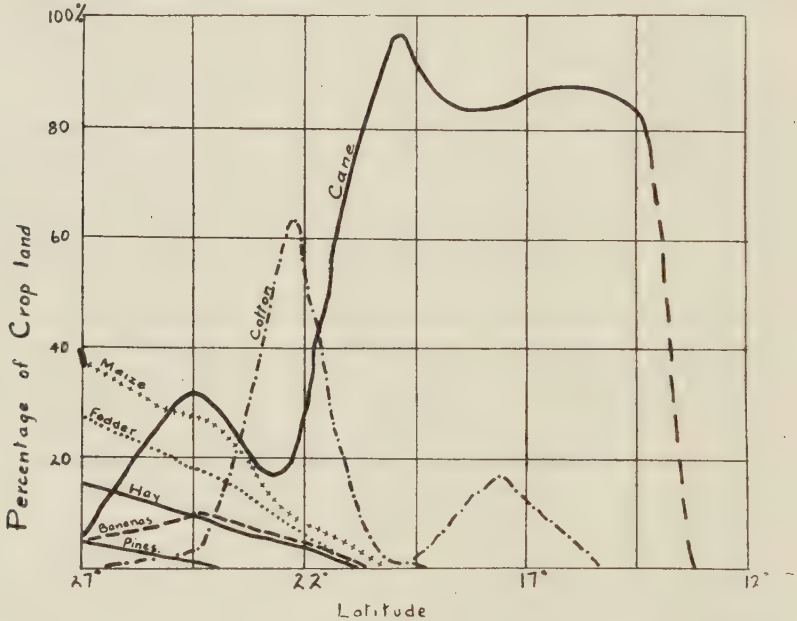


Fig. 1.—The variation of land utilisation with latitude on the Queensland Coast.

The growing of cane in Queensland is confined very definitely to the coast, usually in the river valleys and on the slopes of the smaller hills within a few miles of their mouths. Inland in the middle and upper courses of the rivers the country is usually too rugged for cultivation, and cattle may take the place of crops. The most important cane areas are the valley floors, with their fertile alluvial soils, which are very often the product of the weathering of the volcanic rocks under the conditions of heavy rainfall and luxuriant plant life. These soils, however, are not by any means continuous along the coast, for many areas have very poor soils in close proximity to those of the richest type. The main agricultural regions form a series of basins connected only by the coastal railway from Brisbane to Cairns; this disconnected arrangement of centres of population being characteristic of the Queensland coast, but unusual in Australia. Almost the whole of the coast from the N.S.W. border to Cape York received more than 40in. of rain per annum, the 40in. isohyet running roughly parallel to the coast from Brisbane to Cairns. There are two centres of much heavier rainfall, one near Mackay, where a small area receives over 70in., and the other centring around Hervey Creek, just south of Cairns, with a maximum of 160in. Innisfail receives approximately 140 in., and Cairns 90in. The tropic cuts the coast at Rockhampton, and temperature increases steadily to the north

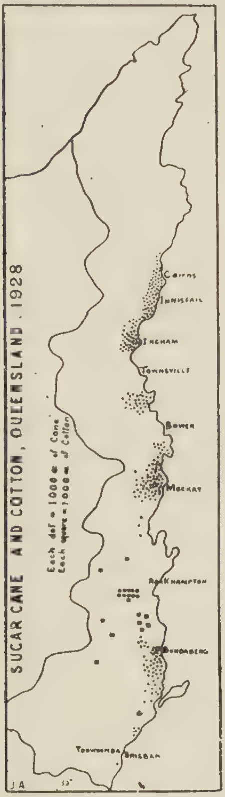

SUGAR CANE AND COTTON, QUEENSLAND. 1928
Each dot = 1000 ac of Cane
Each square = 1000 ac of Cotton
Cairns
Innisfail
Ingham
Townsville
Bowen
Mackay
Rockhampton
Bundaberg
Toowoomba
Brisbane
J A

Fig. 2.—The distribution of sugar-cane and cotton in Queensland.

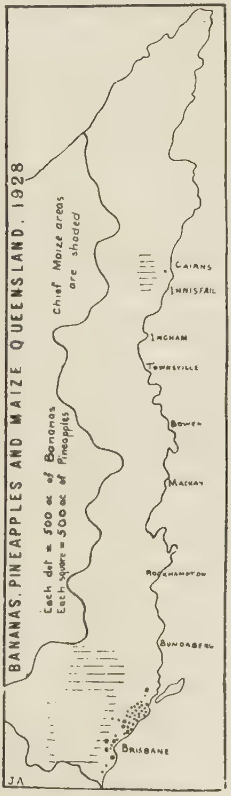

BANANAS, PINEAPPLES AND MAIZE QUEENSLAND. 1928
Chief Maize areas are shaded
Each dot = 500 ac of Bananas
Each square = 500 ac of Pineapples
Cairns
Innisfail
Ingham
Townsville
Bowen
Mackay
Rockhampton
Bundaberg
Brisbane
JA

Fig. 3.—The chief banana, pineapple, and maize districts on the Queensland Coast. Note the opportunity afforded by the high Atherton Plateau behind Cairns for the growing of maize.

to some 80 deg. F. at the base of Cape York Peninsula. From the map of the distribution of cane, then, we may say that the main part of the crop is grown within the tropics in those areas where the most favourable conditions of rainfall and soil coincide. The densest areas at Mackay, Ingham, and Innisfail-Cairns are well shown. There has been since the beginning of the century a marked increase in the acreage devoted to the crop in the tropical areas, with a corresponding decrease in the southern districts. Most of the cane is milled near the growing area, and there were in 1928 35 mills, employing over 6000 people. It is then carried either by ship or by rail to the central markets.

A consideration of the growth of cane cultivation from the beginning in Queensland is interesting. Fig. 4 shows the acreage of cane since 1860, plotted on the logarithmic scale, so that equal rates of increase per cent. show the same curve. It is evident that after the first decade cane was well established, and that there have only been minor fluctuations in the normal increase of acreage. Perhaps the longest period of retrogression was that which began in 1886, and continued through the early 90's, seven years elapsing before the acreage reached the point it had achieved before. Before 1890 there had been considerable agitation regarding the employment of kanaka labourers in the canefields, which was stimulated by the publicity concerning the methods of recruiting in the Islands. At the beginning of the decade, therefore, the importation of kanakas was prohibited, but, when the effect of this move on the cane industry was seen, the prohibition was withdrawn. In the years of the decade 11,000 islanders entered the cane regions of Queensland, but there was always considerable uncertainty, and in 1902 it was decided that the importation of labourers should cease, and that all islanders should be repatriated by 1906. The temporary check in 1890 and surrounding years is shown on the graph. From the middle 90's onwards, however, there was something of a boom, and the rate of increase then attained was not again equalled until after the war. Undoubtedly the cultivation of cane the world over benefited from the paralysis of the beet-growing industry in Central Europe during the war, and cane gained an advantage then that it does not seem likely to lose. The steady expansion of the crop in Queensland argues well for the future of the industry, and it must be remembered that it is still being grown under "artificial" economic conditions, and that until is can be said to stand on its own feet economically, one must speak with some measure of reserve of the success of cane cultivation. One of the most interesting features, to the academic mind, however, is that here the experiment of agriculture by whites in the tropics, with exclusively white labour, is being given a complete trial.

Turning to some sub-tropical products in the case of bananas and pineapples, we find that Queensland is, and seems likely to remain, the most important producer in Australia. The coastal districts around Brisbane have the best conditions possible for the growth of both fruits, but they are not extensively grown further north than Maryborough, although as far north as Cairns bananas and pineapples are grown in small areas. While the question of markets is no doubt important, and the distance which fruits grown on the north coast must travel before they reach the distributing centres, must militate against very extensive cultivation under present conditions, it appears that there are also other factors at work. Of these the chief are rainfall and soil conditions, for it has been found by experience that, contrary to the facts in other pineapple-growing countries, the finest quality is obtained when the rainfall is relatively small. The Brisbane district has a rainfall of something over 50in., with an annual average temperature of some 65-70 deg.; while in other countries both values are considerably higher in the best regions. The second factor mentioned, that of soil condition, is important, for, though pineapples are grown on a great variety of soils, varying from heavy loams to thin sandy soils, perfect natural drainage is essential. It is worthy of note, too, that the samples of both fruits grown in the Moreton district compare favourably with those of any country in the world. Recently the pineapple canning industry has been developed to deal with the surplus fruit; the canned article is being placed on the outside market, where, if judged by quality, it may hope to compete with the best grade of Hawaiian fruit. It is noteworthy that the curves in Fig. 4 relating to cane, bananas and pineapples have much the same trend; one that is indicative of steady advance.

Future lines of advance as regards the two fruits would seem to be in the direction of more intensive cultivation in the Moreton district, and gradual extension in the more favourable areas in the north along the coast, according as the organisation for marketing and distributing improves. Particularly, too, should be remembered the importance a flourishing export trade of canned products would have for the whole State.

The cotton crop is in a very different position. A glance at Fig 4 shows that the acreage devoted to the crop has varied enormously since the first efforts were made during the 60's. The peak was reached in 1924, but since then the acreage has declined enormously, and, although the rate of decrease has fallen off in most recent years, from analogy with past conditions it would appear as though a further decline were inevitable. The crop in 1928 was 12,200,000 lbs., and was valued at £213,000, and of this approximately one-tenth was exported to the United Kingdom, and valued at £60,000.

The crop in Queensland is grown generally on the inner side of the coastal belt, where the rainfall is not so heavy, varying from 25 to 40 in., and particularly in a strip of country inland from Bundaberg and Rockhampton. The densest region at present is around Mt. Morgan, but in many parts of the coast small fields are sown. The many attempts that have been made to place the crop on a sound basis have failed, not because of climatic disabilities, for, as Griffith Taylor has shown (Aust. Ass. Adv. Sci., 1923), there are broad areas from Sydney to Rockhampton which agree with the U.S.A. cotton areas as regards climate, while the coast from Rockhampton to Derby in W.A. has similar conditions to those of the Indian cotton areas; and not because of markets, especially since the ravages of the boll-weevil in the U.S.A. crop. The main trouble lies undoubtedly in economic and partly in administrative conditions. The cotton grown in Queensland under the extensive cultivation system of a typically young country, with its concomitant poorly organised marketing and distributing facilities, high productive costs, and small yields per acre, and especially with the present conditions of entirely white labour, cannot hope to compete on an open market with the crops of the older settler, highly-organised farms of U.S.A., India and Egypt, with their abundant cheap coloured labour and peasant proprietors. One temporary expedient seems to lie in the direction of Government bounties, the line followed with regard to so many of Australia's products, but where there is only a small and limited home market, the farmer cannot hope to pay expenses with the amount sold locally and make his profit from that sold abroad. Hence all the assistance offered by Governments has not given the farmer sufficient confidence in the future of the crop to induce him to specialise in its cultivation. The future of cotton, as of many other tropical crops, e.g., coffee, and of the greater part of our tropical agricultural lands seems to depend rather more upon politics than upon geographic factors.

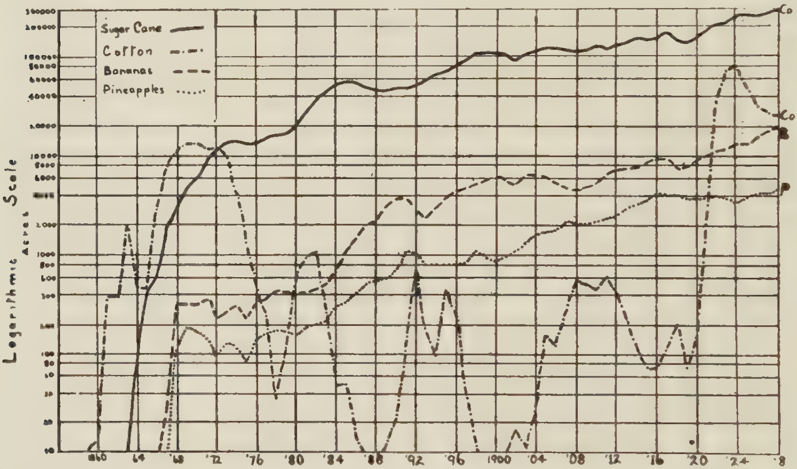


Fig. 4.—The increase in cultivation of the sub-tropical crops in Queensland since 1860, plotted on the logarithmic scale.

Geographical Society of N.S.W.

REPORT OF THE COUNCIL FOR THE YEAR ENDED 30th JUNE, 1930.

Presented at the Annual Meeting Held in the Royal Empire Society's Rooms, 8th July.

The Council have much pleasure in presenting their Third Annual Report.

Membership.—During the year 39 new members were admitted, and twelve names were struck off the list for non-payment of subscriptions for two years. The total membership on 30th June, 1930, was 259.

Meetings of Council.—During the year 10 regular meetings of the Council were held. The attendance of Members of Council at these meetings was as follows:—Prof. W. R. Browne (President), 9; David G. Stead (Vice-President), 7; Prof. L. A. Cotton (Vice-President), 4; Dr. C. Anderson (Vice-President), 9; Miss D. R. Taylor (Vice-President), 8; Capt. F. J. Bayldon, 7; Frederick Daniell, Esq., 2; D. C. Ferguson, Esq., 7; Comm. R. C. Garsia, 1; H. W. Hamilton, Esq., 3; D. J. Mares, Esq., 1; H. B. Mathews, Esq., 5; A. L. Nairn, Esq., 5; Capt. A. W. Pearse, resigned in May; C. V. Potts, Esq., 3; Miss M. Roseby, retiring, but invited to remain till end of year; Miss E. Slack, 8; M. F. Albert, Esq. (Hon. Treas.), 9.

Council.—It is with great regret that the members of Council record the resignation of the Honorary Secretary, Mr. B. M. Mackenzie, and they wish to take this opportunity of expressing their sincerest appreciation of him for the invaluable services he has rendered the Society since its inception. Dr. M. Bentivoglio was elected Acting Honorary Secretary. On the resignation of Capt. W. A. Pearse, Professor J. Macdonald Holmes, the newly appointed Professor of Geography at the University of Sydney, was elected a Councillor. In May, Mr. Nairn was appointed Acting Treasurer, while Mr. Albert was absent abroad.

Lectures.—Lectures and addresses on a variety of topics of geographical interest were given regularly throughout the year in the Royal Empire Society's Buildings, and their great interest to members was attested by the uniformly large audiences which gathered to hear them. The Society has also received excellent press notices of the various subjects discussed. The lectures, most of which were illustrated by lantern slides or films, were given by prominent men on the following subjects:—

9th July, 1929.—The Development of Northern Australia, with special reference to Australia's Tropical Fisheries, by D. G. Stead, Esq.

13th August, 1929.—The Islands and Natives of the Santa Cruz Group, by E. Le G. Troughton, Esq.

10th September, 1929.—The Belgian Congo of To-day, by M. Henri Segaert.

8th October, 1929.—Irrigation and Rural Water Supply, by H. H. Dare, Esq.

12th November, 1929.—From Cape to Cairo, by E. J. Bryce, Esq.

10th December, 1929.—A Holiday in Central Australia, by Mrs. E. Taylor.

11th February, 1930.—Maps by Professor J. Macdonald Holmes; and The Upper Lansdowne District, by C. T. Grout-Smith.

11th March, 1930.—Town Geography, by Professor J. Macdonald Holmes.

8th April, 1930.—Wanderings in Northern Australia, by Melbourne Ward, Esq.

13th May, 1930.—A Geographer in New Guinea, by G. A. V. Stanley, Esq.

10th June, 1930.—Power and Pleasure in Central Tasmania, by Evan Taylor, Esq.

The Council and members of the Society wish to convey their sincere thanks to the several lecturers who gave such instructive and interesting addresses during the year.

Journal.—The second issue of the "Australian Geographer" appeared in November, and comprised 1200 copies. This represented an increase of 400 on the number of the first issue, and the Council felt justified in its action, in view of the great demand for the previous issue. The standard of the first issue has been well maintained, and the thanks of the Society are due to its editors, Mr. D. G. Stead and Miss D. R. Taylor. Chiefly with a view to increasing the number of issues per annum, a request was made to the Hon. the Minister for Education for a small subsidy, such as is given to other societies in the State, but, owing to the financial situation, the Minister, while sympathetic, was unable to accede to the request. The Society is again under a debt of gratitude to Mr. M. F. Albert, who defrayed the cost of the many attractive plates used to illustrate the last issue of the "Geographer".

Federation.—The Council gave some consideration to the possibility of linking up the Society with other similar societies in the Commonwealth, but eventually decided that the time was not yet ripe for recommending such a step.

Australasian Association for the Advancement of Science.—Miss Taylor, Professor Macdonald Holmes and Professor Browne were appointed delegates to the Brisbane meeting of the Association, held in May.

Exchanges.—The following journals have been received:—Geografica Italiana, Rome; Societe de Geographie, Geneva; cal Society; Liverpool Geographical Society; Reale Societa

Geografica Italiana, Rome; Societe de Geographie, Geneva; Natural History Journal, published by American Museum of Natural History; Societe de Geographie, Paris.

On behalf of the Council—

(Sgd.) W. R. BROWNE, President.
M. BENTIVOGLIO, Acting Hon. Secretary.

INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 30th JUNE, 1930

EXPENDITURE:	£	s.	d.	INCOME.	£	s.	d.
To Printing & Stationery	6	18	11	By Subscriptions ..	112	2	6
„ Postages	26	8	2	„ Advertising in Geographer	8	0	0
„ Sundry Expenses ..	25	14	4	„ Geographer Sales	4	19	5
„ Hire Hall	26	0	0	„ Excess Expenditure over Income ..	29	15	2
„ Geographer	61	0	8				
„ Bad Subs., written off	8	15	0				
	£154	17	1		£154	17	1

BALANCE SHEET AS AT 30th JUNE, 1930.

LIABILITIES.		£	s.	d.	ASSETS	£	s.	d.
Accumulated Funds at June 30, 1929	£37 9 11				Cash at bank	2	2	3
Less Excess Ex-p're. over Inc.	29 15 2				Subs. outstanding	10	17	6
		7	14	9				
Subs. paid in adv.		5	5	0				
		£12	19	9		£12	19	9

(Sgd.) A. L. NAIRN, Hon. Acting Treasurer.

I hereby certify that I have examined the Books and Vouchers of the Society, and that the above is a true and accurate Statement of the Society's affairs as shown by the Books.

(Sgd.) E. G. TROUTON, Hon. Auditor.

OFFICIAL ADDRESS: SCIENCE HOUSE

Will members please note that the official address of the Geographical Society of New South Wales is now Science House, corner of Gloucester and Essex Streets, Sydney. All communications should be addressed to the Honorary Secretary at that address. Members may pay their subscriptions at the office of Science House and may also obtain copies of the "Australian Geographer" there—Part 2, price 2/6; Part 3, price 2/-.

Note.—This does not affect the monthly meetings of the Society, which are still held in the hall of the Royal Empire Society, 17 Bligh Street, Sydney.—Ed.

GEOGRAPHICAL SOCIETY OF NEW SOUTH WALES

LIST OF MEMBERS.

Abbott, Miss J., Oxford Rd., Strathfield.
Abbottsmith, F. A., Narrabri.
Adams, Miss M., View St., Woollahra.
Albert, M. F., F.R.G.S., 137 King St., Syd.
Allen, A. M., Dept. of Lands, Sydney.
Anderson, C., M.A., D.Sc., Director, Aust. Museum, Sydney.
Andrews, John, Jersey Rd., Artarmon.
Aurousseau, M., 65a Market Lane, Manly.
Back, Miss A., West St., Petersham.
Back, Miss K. D., West St., Petersham.
Bailey, Mrs. M., 20 Paradise Av., Rsville.
Baldwin, Miss N. J., 85 Hewlett St., Waverley.
Bayldon, Capt. F. J., Navigation Sch., Syd.
Beale, Miss J., Homebush Rd., S'field.
Bentivoglio, Dr. Marie, Teachers' College, University.
Bentley, A. M., 20 Paling St., Leichhardt.
Beresford, Miss P., Interm. High School, Tumut.
Berry, M. L., 275 High St., Chatswood.
Bishop, E. J. H., Mann St., Armidale.
Bishop, J. E., 60 Bay St., Sydney.
Blick, C., 5 Northumberland Av., Stanmore.
Bowler, L. H., Dept. of Lands, Sydney.
Brewster, Miss A., 13 Loftus St., Ashfield.
Broadley, H., Moore Coll., Univ.
Brodie, F. T., Fort St. Boys' H.S., P'sham.
Broinowski, F. J., Canberra, F.C.T.
Brown, H. L., Culwulla Chrs., Sydney.
Brown, Miss I. A., Geology Dept., Univ.
Browne, Prof. W. R., Geology Dept., Univ.
Brownhill, D. J., 19 O'Connell St., Sydney.
Bryce, Ernest, Nelson Rd., Killara.
Burnett, J. H., 44 Mary St., Longueville.
Burrell, Miss D., Smith St., Went'ville.
Burrell, Miss L. H., H. School, Armidale.
Butson, Miss J., 67 Belmont St., Mosman.
Byrne, Miss S., Bondi Beach.
Campbell, Mrs. A., 179 Bridge Rd., Glebe Point.
Campbell, Miss M., 18 Greville St., Rndwk.
Campbell, Miss J. W., 179 Bridge Rd., Glebe Point.
Carrington, L. C., 23 Fairlight St., Manly.
Carroll, G., Cranbrook, Edgecliffe.
Castleman, A. W., 85 Livingstone Rd., Petersham.
Challands, G. L., 76 Balfour Rd., Rose By.
Clark, C. T., Valley Rd., Warrawee.
Clark, W. E., Cambridge St., Epping.
Clifton, Miss M., 109 Albert Rd., H'bush.
Close, J. H. C., 56 Glover St., Mosman.
Cohen, Rabbi F. L., 40 Bayswater Rd., Darlinghurst.
Conacher, C. W. D., 79 Pitt St., Sydney.
Connelly, Miss I. G., 303 Liverpool Rd., Ashfield.
Cotton, Miss E. A., 33 Ashley St., Hornsby.
Cotton, Prof. L. A., Univ., Sydney.
Cousins, G. W., Angus & Robertson, Syd.
Crago, E. A., 14 Fairmount St., D. Hill.
Craig, Mrs. E. W., H. School, Wollongong.
Culey, Miss A. G., Neirbo Av., Hurstville.
Dallen, R. A., B.M.A. Building, Sydney.
Daniell, F., 139 King St., Sydney.
Dee, T. W. J., Canberra, F.C.T.
Delbridge, Mrs. M. M., Kambala Rd., Bellevue Hill.
Denison, Sir Hugh, K.B.E., Culwulla Chambers, Sydney.
Denman, Miss O. E., 26 The Crescent, Waverley.
De Possell, Mrs. H., 41 Rangers Rd., Cremorne.
Deves, Miss T. F. L., Noble St., Five Dck.
Dickson, E. A., 87 Mi Mi St., Oatley.
Dixson, Dr. T. S., 215 Macquarie St., Syd.
Dixson, W., F.R.G.S., Strand, Sydney. (Life Member.)
Doak, Miss J. K., 114 Belmont Rd., Msmn.
Douglas, M. V., 75 Oberon St., Coogee.
Dowsett, Miss E. D., Roseville Av., R'vlle.
Doyle, Miss O. M., St. Hilda's S., Southport, Q.
Drummond, Miss H. R., B.Sc., 15 Watson St., Neutral Bay.
Dunphy, M. J., 53 Railway Par., Mortdale.
Eames, Miss E., 15 Norfolk Rd., L'ville.
Earp, Hon. G. F., 52 Carrington St., Syd.
Eastwood, Miss L., Edwin St., Tempe.
Emanuel, Miss U. R., Waimea Rd., R'vlle.
Enright, W. J., West Maitland.
Eve, H. D., Canberra, F.C.T.
Ferguson, D. C., 39 Hunter St., Sydney.
Finniss, L. H., Doon, Vic.
Flynn, Miss M. C., Carrington Road, Wahroonga.
Gallagher, Miss E., Teachers' Coll., Univ.
Gamble, Mrs. M. J., Nelson St., Chatsw'd.
Garsia, Comm. R. C., Garden Is., Sydney.
Gentle, Miss L., 17 Helen St., Lane Cove.
Gerber, Miss L., 23 Murdock St., C'morne.
Gilmour, Miss L. S., Univ., Sydney.
Godden, Miss R. I., Interm. H.S., Leeton.
Gorrell, S., Wallis St., Woollahra.
Gossett, R. G. W., Mary St., Longueville.
Gow, Miss H., 80 Cook Rd., Cent'nial Pk.
Grady, Miss A., H. School, Albury.
Graham, Miss M. L., 52 Park Rd., B'wood.
Graham, Miss V., 52 Park Rd., Burwood.
Gray, A. J., 6 Augusta St., Concord.
Grout-Smith, C. T., 15 Woodville St., Hurstville.
Halligan, G., F.R.G.S., Station St., Pymble.
Hamilton, H. W., B.Sc., Teachers' Coll., Univ., Sydney.
Hawkins, W. E., Bold St., Burwood.
Henriques, Miss J. M., 32 Cranbrook Av., Cremorne.
Henriques, Mrs. M. C., 32 Cranbrook Av., Cremorne.
Heron, Mrs. E., 45 Rangers Rd., Cremorne.
Herring, Mrs. B. D., Maryborough, Vic.
Hewins, Mrs. L. I., Macleay St., Potts Pt.
Hill, E. McC. Shea-, Denning St., Coogee.
Hindmarsh, P., Teachers' Coll., Univ., Syd.
Hinks, L., ''Greenknowe.'' Darlinghurst.
Hogan, J. C., 44 Myrtle St., Stanmore.
Holmes, Prof. MacDonald, B.Sc., F.R.G.S., Dept. of Geog., Univ.
Hudson, E. T., c/o Turner & Henderson, Sydney.
Hunt, K. R., Belcote Rd., Longueville.
Jackson, C. F., King St., Marrickville.
Johnson, Miss J., 24 Broughton Rd., Homebush.
Joplin, Miss G., Wentworth St., Eastwood.
Kalergi, Count K. H. C., 62 Womerah Av., Darlinghurst.
Kelly, Miss M., 33 Stanley Av., Mosman.
Kennedy, H. E., 92 Union St., N. Sydney.
King, Sir Kelso, 117 Pitt St., Sydney.
King, H. W., Woy Woy.
King, J. McE., Teachers' Coll., Univ., Syd.
Kirwan, W. T., Angus & Robertson, Syd.
Kitson, Miss F., Abbotsleigh, Wahroonga.
Knight, Miss H. R., 6 Hermitage Rd., West Ryde.
Krippner, R. W. C., 172 Albany Rd., Stanmore.
Langford, R. G., 23 Oak St., Bathurst.
Larcombe, E. E., 74 Wilga St., Concrd. W.
Lawry, Miss D. M., 24 Iredale Av., C'mrn.

Lawson, Miss J., 19 O'Sullivan Rd., Rose Bay.
Lawson, Miss M. M., 16 Tupper St., M'vll.
Lee, R. S., St. John's Coll., Morpeth.
Legg, Miss E., B.Sc., 36 Herbert St., Rockdale.
Levis, R., 60 Stuart St., Longueville.
Ling, Miss M., Teachers' Coll., Univ.
Livingstone, Miss A., Frensham, Mittagng.
Livingstone, W. F., 28 Lenthall St., Kensington.
Lowndes, A. G., 23 Palmer St., Balmain.
Lyons, W. J., Royal Exchange, Sydney.

MacDonald, Miss H. S., 45 Wentworth Rd., Strathfield.
Macey, Miss R. C., 120 H'bush Rd., St'fld.
Macfie, H. C., 14 Martin Pl., Sydney.
MacInnes, A. R., Clifton, N.S.W.
Mackaness, G., Teachers' Coll., Univ.
Mackay, D. G., F.R.G.S., Port Hacking.
Mackenzie, B. D. M., 17 Bligh St., Sydney.
Mackenzie, H. M., 105 Pitt St., Sydney.
Mackley, Miss A., 111 Ridge St., N. Syd.
Makin, W., B.A., LL.B., Reg. Genl's Dept., Sydney.
Marchant, Miss D. H., 11 King St., Ashfld.
Mares, D. J., Div. Meteorologist, Sydney.
Mathews, H. B., B.A., Surv.-General, Dep. of Lands, Sydney.
McCarthy, D., Public School, Balgownie.
McCausland, C., 75 Smith St., Dulwich H.
McGarry, Miss K. P., Ryde Rd., H. Hill.
McLean, Miss G., P.L.C., Croydon.
McLuckie, Prof. J., Botany Dept., Univ.
McMaster, F. D., Cassilis.
Middleton, Miss F. E., B.Sc., 479 Alfred St., N. Sydney.
Miller, C., Bank N.S.W., Penrith.
Millin, B., Royal Exchange, Sydney.
Moller, Miss Z., 25 Layton St., Cmprdwn.
Moore, F. H., F.R.G.S., Union Club, Syd.
Morris, L., 14 Beach Rd., Clovelly.
Moss, P. C., High School, Hay.
Moyes, Comm. M. H., B.Sc., F.R.G.S., H.M.A.S "Penguin," Sydney.
Murray, Miss A. S., 141 Holt Av., C'mrne.

Nairn, A. L., Norfolk Rd., Longueville.
Naylor, G. K., 26 O'Connell St., Sydney.
Nicholl, Dr. H., Mudgee.
Noble, A. G., 16 Barrack St., Sydney.

O'Connor, D. P., 26 Campbell St., Waverly.
Oliver, Miss E. H., 16 Bridge St., M'ville.

Palmer, Miss B. H., Condamine St., Balgowlah.
Parnell, Miss M., Nicholas Av., Campsie.
Pearse, Capt. A. W., F.R.G.S., 10 Bligh St., Sydney.
Piggott, O. A., 13 Capt. Piper's Rd., Vaucluse.
Pont, Miss M. W., 20 Watkins St., Bondi.
Potts, C. V., 28 O'Connell St., Sydney.
Potts, Mrs. C. V., Birra Burra Av., V'clus.
Powell, Miss D. K., 35 Albert Rd., S'field.
Powell, J., Rangers Rd., Cremorne.
Price, H. J., 185 Bridge Rd., Glebe.
Pulsford, S. W., Smith St., Epping.
Pye, E., 50 Harris St., Harris Park.
Rappeneker, Miss H. B., Mullumbimby.

Rickard, Sir A., K.B.E., 84 Pitt St., Syd.
Rickard, L. G., Park Rd., Naremburn.
Ritchie, A. A., Angus & Robertson, Syd.
Robinson, H. E. C., 221 George St., Syd.
Roche, Miss M. H., 19 Mandalong Rd., Mosman.
Roseby, Miss M., B.A., Redlands, C'morne.
Ross, Dr. C., 225 Macquarie St., Syd.
Rowe, J. B., 8 Jarocin Av., Forest Lodge.
Ryan, Miss L., Wickham St., Arncliffe.

Sargeant, F. A., Sisters' Cres., D'moyne.
Sargeant, Miss R. A. I., Sisters' Cres., Drummoyne.
Scriven, Mrs. M. S., Gore Hill.
Shillington, Mrs. S. J., Rabaul, N. Guinea.
Simpson, E. J., Tirrikiba.
Skirving, Dr. R. Scot-, 185 Macquarie St., Sydney.
Slack, Miss E. M., C. of E.G.G.S., Nth. Sydney.
Small, Miss J. V. D., Alstonville.
Smerdon, G. M., 115 Pitt St., Sydney.
Smith, H. L., 58 Margaret St., Sydney.
Smith, H. R., Moore College, Univ.
Smythe, F. T., 81 Will. Ed. St., L'ville.
Soady, T. A., Smith Wylie & Co., Sydney.
Somerset, A., 139 Clarence St., Sydney.
Soul, Miss J. E., P.O. Box 3384 R., Syd.
Spier, W., 10 Bligh St., Sydney.
Stanley, G. A. V., Pt. Moresby, N. Guinea.
Stanley, Miss H. V., 26 Wllngtn St., Bondi.
Stanley, M. S., 109 Pitt St., Sydney.
Stead, D. G., "Boongarre," Watson's By.
Steinbeck, W. M., Tech. School, Granville.
Stenhouse, Miss D. M., 18 Garfield St., Carlton.
Stephen, Miss D., B.Sc., Paradise Av., Roseville.
Stewart, R., 13 Nelson St., Chatswood.
Stuart, M. R., 45 McMillan Av., R'ville.
Sully, W., Olphert Av., Vaucluse.
Sussmilch, C. A., East Sydney Tech. Coll.
Sutcliffe, Miss M. M. H., Richmond House, Woollahra.
Swan, L. A., 5 Mount St., Strathfield.
Tabberer, Mrs. A., 3 Awaba Rd., Balmoral.
Taylor, A. S., F.R.G.S., Canberra.
Taylor, Miss D. R., Univ., Sydney.
Taylor, E. P., Beaconsfield Rd., Artarmon.
Taylor, Mrs. E. P., Beaconsfield Rd., Artarmon.
Taylor, Mrs. L. A. G., Brierley St., Msmn.
Taylor, Prof. Griffith, D.Sc., F.R.G.S., University of Chicago.
Thatcher, Rev. Dr. G. W., M.A., D.D., Camden College, Glebe Point.
Thomas, J. F., Tenterfield.
Thorpe, W. W., Aust. Mus., Sydney.
Tindall, Miss A. M., 65 Sutherland St., St. Peters.
Trouton, E. G., 16 Blackstone Flats, E. By.
Tuckerman, Miss M. H., 6 Joseph St., Ashfield.
Turner, R. A. B., 25 Hale Rd., Mosman.
Tyler, C. F., 17 Concord Rd., Strathfield.

Wade, Rev. R. T., "Headfort," Pennant Hills.
Walker, Miss K., 57 Bay Rd., N. Sydney.
Wallas, Mrs., c/o Mrs. L. A. G. Taylor, Mosman.
Waller, Miss M., 90 Cambridge St., S'mre.
Wallis N., Carbray Flats, Waverton.
Wallis, Miss G., Carbray Flats, Waverton.
Walter, E. L., F.R.G.S., Australian Club, S.
Waterhouse, L. L., Univ., Sydney.
Waterhouse, W. L., Univ., Sydney.
Watt, R. G., League of Nations Union.
Watts, Mrs. G. E., Burra Rd., Artarmon.
White, E. R., 30 Beach Rd., Randwick.
Whitham, Miss A. Ruth, Univ., Sydney.
Whitham, Miss B. A. B., Univ., Sydney.
Whitham, Miss N., Univ., Sydney.
Whittell, H. R., Lilla Rd., Pennant Hills.
Wiesener, Miss B., Jersey Rd., S'field.
Wilkinson, T. L., Overland Sydney Ltd.
Willshire, Miss J., 18 Prince St., Mosman.
Wilshire, Miss O., 17 Claude Av., C'morne.
Wilson, Miss C. G., Lorne Av., Killara.
Wilson, J. F., Sydney Ferries, Balmain.
Wilson, L. G., Dalgety & Co., Sydney.
Wylie, D. S., 14 Spring St., Sydney.

Wymark, F., Angus & Robertson, Sydney.

Yarrington, H. De C., Burns Philp (South Sea) Co., Tarawa, Gilbert Islands.
Young, Dr. D. M., Gilbert Is., W. Pacific.